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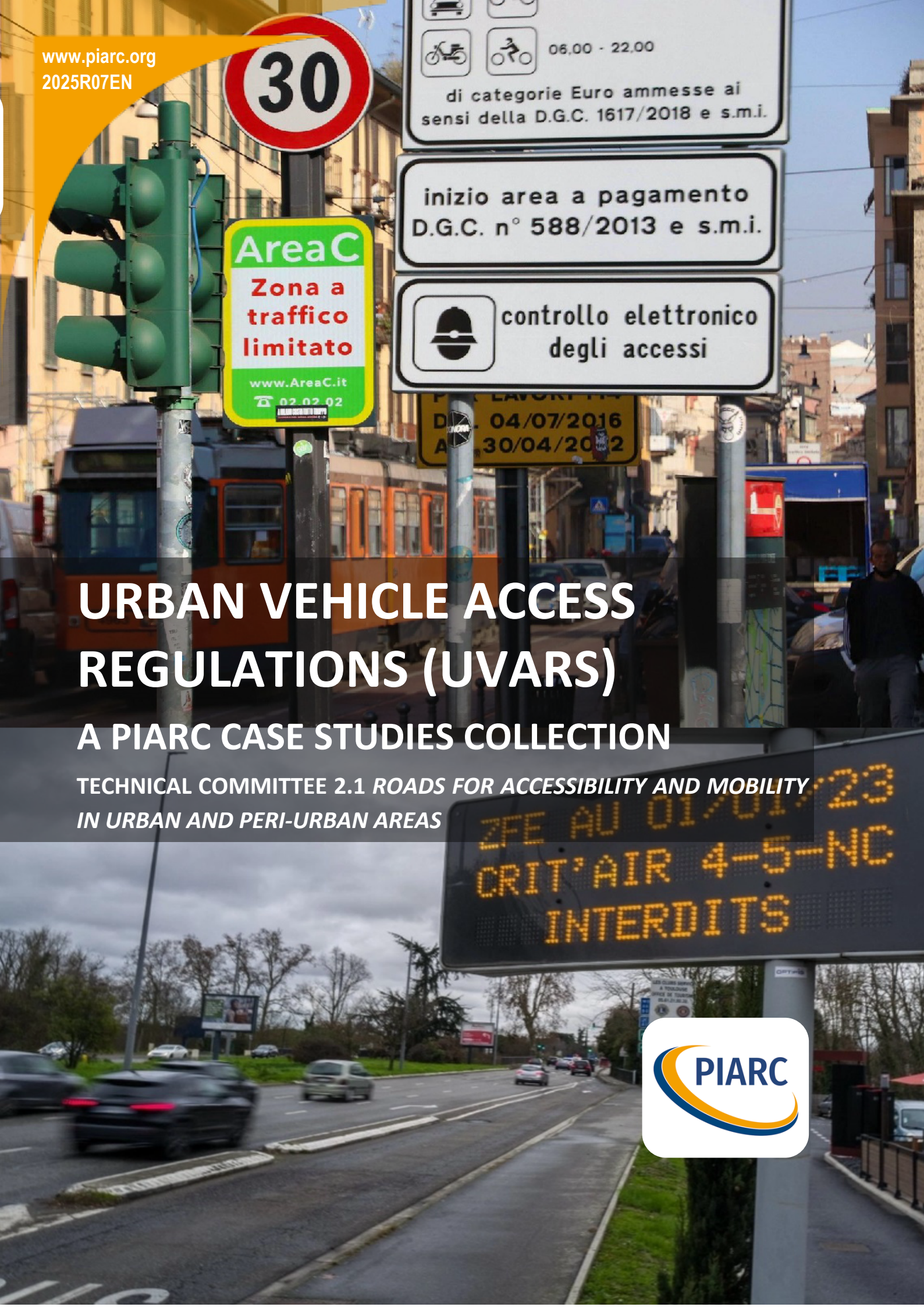

URBAN VEHICLE ACCESS REGULATIONS (UVARS)

A PIARC CASE STUDIES COLLECTION

TECHNICAL COMMITTEE 2.1 *ROADS FOR ACCESSIBILITY AND MOBILITY IN URBAN AND PERI-URBAN AREAS*

PIARC

STATEMENTS

The World Road Association (PIARC) is a nonprofit organisation established in 1909 to improve international co-operation and to foster progress in the field of roads and road transport.

The study that is the subject of this report was defined in the PIARC Strategic Plan 2024– 2027 and approved by the Council of the World Road Association, whose members are representatives of the member national governments. The members of the Technical Committee responsible for this report were nominated by the member national governments for their special competences.

Any opinions, findings, conclusions and recommendations expressed in this publication are those of the authors and do not necessarily reflect the views of their parent organisations or agencies.

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AUTHORS/ ACKNOWLEDGEMENTS

This report has been prepared by the Technical Committee 2.1 “Roads for Accessibility and Mobility in Urban and Peri-urban areas” of the World Road Association (PIARC), particularly by the Working Group 2 (WG2) in charge of the Issue 2.1.2. “Urban Vehicle Access Regulations (UVARS)” of the Strategic Plan.

The Technical Committee is chaired by Andrea SIMONE (Italy). The leader and co-leader of the WG2 are Wanda DEBAUCHE (Belgium) and Sandrine ROUSIC (France), respectively.

The leader, co-leader and Alvaro DEFALQUE (Belgium) have assumed the role of management and coordination in this exercise with many virtual meetings during the 2024-2027 cycle.

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Overall contents review of this report has been undertaken by A. Defalque, S. Rousic, W. Debauche, R. Dostal.

The language review of the original English version was done by Izak Van Der Linde and N. Ngomane.

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EXECUTIVE SUMMARY

2025R07EN

URBAN VEHICLE ACCESS REGULATIONS (UVARS)

A PIARC CASE STUDIES COLLECTION

This **report** presents a global collection of case studies on Urban Vehicle Access Regulations (UVARs), compiled by the Technical Committee 2.1 "Roads for Accessibility and Mobility in Urban and Peri-Urban Areas" of the World Road Association (PIARC). It is one of the three deliverables from Working Group 2.1.2, which specifically focuses on UVARs for the 2024–2027 Strategic Plan cycle. The two other deliverables are the literature master list and the briefing note.

Urban areas face increasing challenges linked to traffic congestion, air and noise pollution, road safety, and the adequate use of public space. In response, UVARs have emerged worldwide as strategic tools to manage and regulate vehicle access to urban areas. These measures aim to reduce negative impact of motorized traffic by applying geographical restrictions based on vehicle type, emissions, time of access, or user category.

The **objective** of this report is to document and disseminate a broad range of UVAR schemes implemented across different cities and regions. The case studies collected here reflect diverse regulatory approaches and urban contexts, including middle- and low-income countries. It provides insight into the impacts, benefits, implementation processes, and the challenges faced—thus serving as practical examples for policymakers, practitioners, and researchers.

The **scope** of this report is limited to descriptive and analytical presentations of case studies. It does not contain normative conclusions or policy recommendations. These will be addressed in a subsequent PIARC publication in the form of a Briefing Note, which will synthesize findings and propose guidance for cities considering UVARs.

The report is structured as follows:

- **Chapter 1: Introduction** – Contextualises urban mobility challenges and the rationale for UVARs.
- **Chapter 2: Definition and Typology of UVARs** – Establishes a conceptual framework and categorises UVAR models.
- **Chapter 3: Methodology** – Outlines the approach used to collect and analyse the case studies.
- **Chapter 4: Results of Multimodal Good Practice Collection** – Presents detailed results of UVAR collection worldwide.
- **Chapter 5: Case Studies** – Presents detailed examples of UVAR implementation worldwide, following a standardised fact sheet template.
- **Chapter 6: Conclusion and Next Steps** – Summarises key observations and outlines the future work of the Briefing note

This work contributes to PIARC's broader mission of supporting sustainable and inclusive road policies by addressing the relationship between mobility, environmental health, and spatial justice in urban and peri-urban environments.

CONTENTS

1. INTRODUCTION

1.1. BACKGROUND

Metropolitan areas around the world, whatever their level of development and income, face several common traffic problems that deeply affect their functioning, the quality of life of their residents and their overall attractiveness (for private people as well as economic factors). This applies to both urban and peri-urban areas – however traffic issues and the associated negative impacts are exacerbated in the very dense cores of the metropolitan areas.

First, traffic congestion is a major challenge. Road infrastructure often reach saturation levels, leading to significant delays, low predictability of transportation time, reduced transport efficiency, and substantial economic losses, estimated at several hundred billion dollars annually, according to the World Bank in 2022 [1].

Moreover, parking shortages is an increasing issue, and private cars are immobile for approximately 95% of the time [2], occupying valuable public space and influencing travel behaviour, congestion levels, and urban form (International Transport Forum, 2019). In England, an estimated 31% of public space in residential streets is used for parking (Transport for London, 2022) [3]. The extremely low utilization rate—vehicles moving on average only 4% of the time illustrates the importance of parking regulations within UVAR strategies. With urban expansion, the demand for parking often exceeds the available supply, resulting in inefficient land use and worsening congestion, especially due to vehicles searching for parking spaces. The International Transport Forum emphasized this problem in 2019 [2].

Road safety also remains a major concern. Each year, approximately 1.3 million deaths occur on the world's roads, with a significant portion of these accidents taking place in urban areas, according to data from the World Health Organization in 2021 [4]. Moreover, there is strong empirical evidence that pedestrian injuries and fatalities correlate with traffic volumes and density. In Prague, for instance, accident data normalized by area or network length reveal significantly higher rates of pedestrian casualties in congested districts [5]. This supports the rationale for implementing UVARs that reduce vehicular volumes in high-density pedestrian areas.

Furthermore, the deterioration of road infrastructure presents an economic and logistical challenge. Continuous traffic wear requires significant investment in road maintenance and repair, as highlighted by both the OECD and the World Economic Forum in 2021 [6] : "*every dollar deferred in road maintenance leads to $4 to $5 in future rehabilitation costs*" [7]. On top of that, the World Bank (2022) highlights that poor road conditions raise vehicle operating costs by up to 30% and reduce access to economic opportunity [1]. Moreover, some access regulation schemes generate revenues through fines or fees, which can help fund transport infrastructure and operational costs [8] (European Commission, 2020).

Another challenge lies in public transport issues. Inadequate or overcrowded transit networks push more people to rely on private vehicles, further exacerbating urban congestion. The United Nations Environment Programme highlighted this issue in 2021 [9]. Furthermore, Johannesburg Vehicle Emissions Control Strategy (VECS) explicitly acknowledges that public transport inadequacy is a key barrier to reducing car use and improving air quality [10]. The strategy emphasizes the need for investment in public transport and a transition from car-dominated mobility.

Last but not least, both air and noise pollution pose a threat to public health. The transport sector is one of the main contributors to urban air pollution, emitting high levels of nitrogen oxides (NO_x) and fine particulate matter (PM2.5), both of which directly contribute to respiratory diseases, as highlighted by the OECD in 2020 [11]. Furthermore, traffic congestion significantly amplifies pollutant emissions, especially NO_2 and PM. Studies show that emission levels during peak congestion can be 2–4 times higher than during free-flow conditions [12] [13] (Borken-Kleefeld et al., 2013; ICCT, 2020). This highlights the importance of UVAR schemes that manage peak hour congestion, such as congestion charging or time-based access restrictions. Noise pollution is a significant nuisance. Constant traffic noise has harmful effects on mental and cardiovascular health, as reported by the European Environment Agency in 2021 [14].

In parallel with these global reflections on metropolitan areas, many urban centres, particularly in developed countries, whether large cities or smaller towns, are seeking to reduce traffic in order to calm urban roads and improve the quality of the urban environment.

Indeed, public space is being redefined by the development of new mobility modes, urban densification, evolution in population characteristics and needs, residents' demand for quieter environments, and the need for activities to counteract the health impacts of sedentary lifestyles. Through the implementation of traffic-calmed zones, local authorities seek to achieve multiple objectives: balancing different modes of transportation, reducing accidents and their severity, making city centres more attractive, and fostering a more welcoming urban environment. The development of these zones presents an opportunity to rethink the living and working environment on a broader scale, enhance the value of public spaces, and diversify the use of streets and urban areas.

From the early stage of planning future traffic-calming measures, it is essential to consider the overall organization of circulation across the entire urban area to ensure their effectiveness. The goal is to provide clear and readable routes for all modes of transportation and users, maintain fluid traffic flow, and prevent long-distance vehicle traffic from using secondary neighbourhood streets to bypass congestion instead of staying on main roads.

Urban Vehicle Access Regulations (UVARs) are policy measures designed to manage and restrict vehicle access to specific urban areas to reduce traffic congestion, air pollution, and road safety challenges. UVAR measures can be found on every continent, reflecting a global effort to create more sustainable and liveable urban environments.

Indeed, over time, UVARs have evolved to address changing urban mobility challenges and environmental concerns. Early interventions primarily focused on pedestrianising historic city centres to preserve their cultural heritage and enhance walkability. However, as urbanisation intensified, cities implemented more comprehensive measures, including congestion charging, low-emission zones (LEZs), zero-emission zones (ZEZs), and limited traffic zones (LTZs), among others. We will elaborate more on the UVAR definition and typologies in the second chapter of this report.

These measures serve multiple objectives:

- ✓ Reducing Air Pollution: By restricting access to high-emission vehicles, UVARs help lower levels of harmful pollutants such as nitrogen dioxide (NO_2) and particulate matter (PM). For instance, London's Ultra Low Emission Zone (ULEZ) led to a 44% reduction in NO_2 levels [15] (Greater London Authority, 2021).
- ✓ Managing Traffic Congestion: Policies such as Milan's Area C congestion charge scheme have demonstrated a 30% reduction in vehicle traffic and an increase in public transport use [16] (European Commission, 2016).
- ✓ Enhancing Road Safety: Empirical studies suggest that limiting vehicle access in urban areas can significantly reduce traffic-related injuries. The World Health Organization (2021) reports that road traffic injuries claim approximately 1.3 million lives annually, many of which occur in urban settings [4]. By reducing private car traffic and reallocating street space to safer modes, UVARs can directly contribute to a decrease in pedestrian and cyclist injuries. In addition, traffic restriction measures should be aligned with other planning documents covering peri-urban areas to maintain consistency in spatial development strategies and avoid negative side effects on areas (and their residents) outside the geographical scope of urban regulation measures.

Thus, these challenges require coordinated solutions to improve urban mobility and ensure a better quality of life for city dwellers.

1.2. OBJECTIVES

In the new Strategic Plan (2024-2027), the Technical Committee 2.1 roads for accessibility and mobility in urban and peri-urban areas will start from the results obtained in the previous cycle with a specific focus on coordination with other TCs [17].

As indicated in the terms of reference, the aim of working group 2.1.2 "Urban Vehicle Access Regulations (UVARs)" is to study different solutions of urban vehicle access restrictions and regulations: low emission zones, pedestrian zones and congestion charging zones for example. The aim is to evaluate the effectiveness in terms of reducing congestion, also from the point of view of an integrated urban transportation plan, to analyse the benefits and potential neglected cost.

First, in this report, WG2.1.2 has compiled case studies and best practices on UVAR in several cities and peri-urban areas around the world, focusing on case studies with a proven track record in evaluation and impact assessment.

The case studies represent a set of different types of UVARs, including Low Emission Zones, Limited Traffic Zones, pedestrian areas, congestion charging, and parking access regulations.

This collection aims to gather examples of good practices and illustrate the keys to success. This report should be a source of inspiration for all those involved in mobility who are looking for pragmatic solutions.

All in all, this report does not only aim to describe the PIARC Committee's activities, but to offer an actionable synthesis of existing practices and research in UVARs—emphasising context-sensitive recommendations, replicability, and policy design tailored to different urban environments [18].

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2. DEFINITION AND TYPES OF UVARS

2.1. WHAT IS AN UVAR ?

Urban Vehicle Access Regulations (UVARs) are regulatory measures designed to control or restrict vehicle access to urban infrastructure (zone, lane, entry point, public space) under specific conditions.

According to the 2013 European Commission Staff Working Document on Access Regulations, UVARs are defined as "measures to regulate vehicular access to urban infrastructure" [1] (European Commission, 2013). These regulations adapt to local challenges and priorities, rather than universally restricting vehicle access. Those predetermined access regulation conditions can be vehicle weight or size, time periods (time of day, day of the week etc.), emission levels (either per vehicle or within a certain area), resident status, payment of a certain fee, or occupancy level [2] (Graziani, 2020).

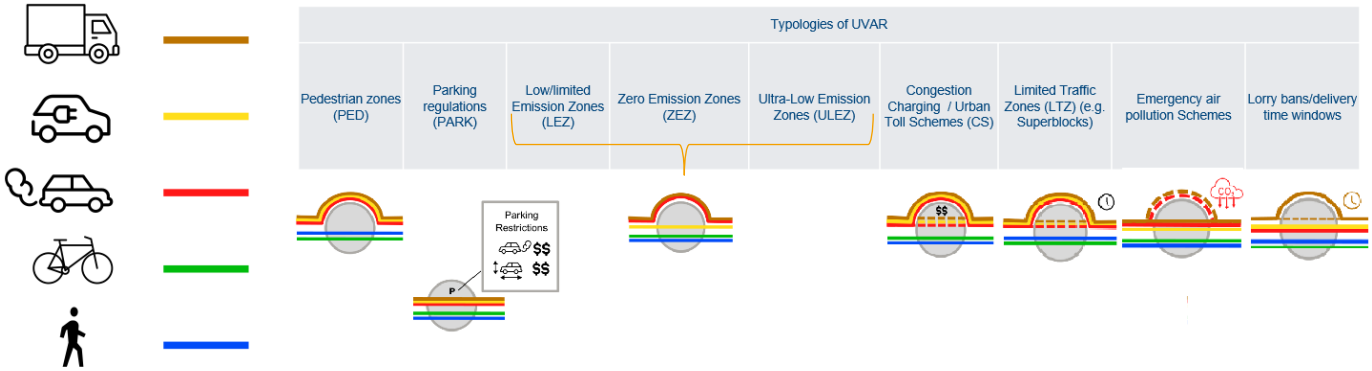
- **Purpose**: UVARs aim to mitigate air pollution, traffic congestion, noise levels, and road safety risks.
- **Conditional Access**: zonal access restrictions are based on predefined conditions such as vehicle type, emissions, resident status, or payment schemes.
- **Dynamic Framework**: UVARs evolve to accommodate changes in urban priorities, technological advancements, and societal needs [3].
- **Integration with Urban Policy**: UVARs align with broader urban strategies for mobility, sustainability, and accessibility.

What is NOT an UVAR:

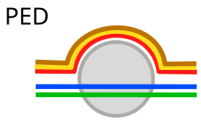
Some urban measures are often confused with UVARs but do not fall under this category within the scope of our PIARC report. UVARs, in our scope, require an explicit regulatory intent to restrict motorised access based on parameters such as vehicle type, time of day, user category, or other defined conditions. For instance, simple pedestrianisation without a regulatory and infrastructural restriction on vehicle access (such as signage, barriers, or camera enforcement) or a supporting policy objective (e.g., emissions reduction or congestion mitigation) is not considered a UVAR in this study. Furthermore, general urban policies—such as speed limits, fuel taxes, or public transport improvements—are not UVARs, as they do not regulate access to specific urban infrastructure. Total prohibitions on all vehicles, including emergency services, also fall outside the UVAR definition, as UVARs must operate under transparent, predetermined access conditions that allow for controlled and differentiated access. UVARs are thus defined by their targeted, conditional regulation of motorised vehicle access, rather than blanket restrictions or general mobility interventions.

2.2. How to classify UVARs ?

The WG2.1.2 classified UVAR measures according to the following typology:



2.2.1. Pedestrian Zones (PED)



Pedestrian zones (PED) refer to areas designated exclusively for pedestrian use, where motorised vehicle access is restricted or banned. A pedestrian zone typically encompasses a square, a road, or a group of contiguous roads where vehicles (motorised or not) are prohibited.

These zones are implemented with the primary aim of enhancing safety, reducing air and noise pollution [4], and improving the overall quality of urban life by creating spaces free from the negative effects of vehicular traffic. In some cases, bicycles may also be allowed; their status within the zone can either be equal to pedestrians or considered "tolerated," meaning cyclists must yield to pedestrians who have priority. Exceptions to the vehicle ban might include a limited number of vehicle categories such as those used by people with reduced mobility (with proof like a badge/permit/sticker), residents needing access to their garages, and delivery vehicles during specific off-peak time windows. In these cases, parking is not allowed, and vehicles are only permitted to travel at walking speed. Emergency vehicles are always granted unrestricted access to pedestrian zones.

Within this report, pedestrian zones are considered UVARs when they meet the criteria of a regulatory access restriction (either spatial, temporal, or functional) targeting vehicle types or behaviours, and serving a broader policy objective such as air quality, safety, or public space enhancement. Most importantly, mere street design without regulatory vehicle restriction does not qualify.

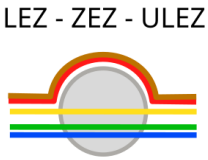
2.2.2. Low/Limited Emission Zones (LEZ)

Low Emission Zones (LEZ) are areas where vehicular access is limited to vehicles that meet specific emissions standards, rather than simply reducing the number of vehicles like Limited Traffic Zones (LTZ). These zones restrict access based on the emissions characteristics of vehicles, ensuring that only those that meet set minimum air quality emissions can enter. Vehicles that do not comply with

these standards are either banned from entering or subject to higher charges. The primary goal of LEZ is to reduce air pollution levels to meet the health-based air quality objectives.

While there are exceptions for certain vehicles such as emergency services, the aim remains consistent: to allow access only to cleaner vehicles. Complying vehicles often need to identify themselves through stickers or registration on a database, ensuring easy enforcement of the LEZ standards. These identification methods are not considered permits but rather a means of verification to streamline compliance and enforcement.

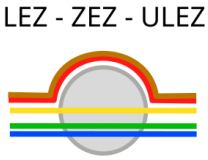
2.2.3. Zero Emission Zones (ZEZ)



Zero Emission Zones (ZEZ) are urban areas where only vehicles that produce no emissions at the point of use are allowed entry, including electric vehicles (EVs), pedestrians, cyclists, and geofenced plug-in hybrid electric vehicles (PHEVs). This stricter form of emission regulation aims to combat both air pollution and climate change by exclusively permitting zero-emission vehicles within designated zones.

Typically, ZEZ can be established by upgrading existing Low Emission Zones (LEZ) to more stringent standards or by integrating zero-emission requirements into current limited traffic zones (LTZ) or pedestrian areas (PED). The implementation of ZEZ often follows a phased approach, gradually tightening restrictions to facilitate adaptation.

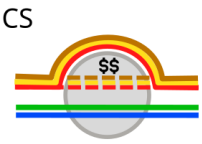
2.2.4. Ultra-Low Emission Zones (ULEZ)



Ultra-Low Emission Zones (ULEZ) are designated areas where access is restricted to vehicles that meet stringent emissions standards, typically more rigorous than those in Low Emission Zones (LEZ). The primary objective of ULEZ is to target and reduce very low levels of pollutants, significantly impacting older diesel and petrol vehicles that fail to meet the emission criteria. Unlike pure LEZ, which often do not significantly reduce traffic levels, ULEZ can lead to a noticeable decrease in motor traffic due to the strict standards they enforce [5].

In London, the ULEZ is specifically applied to areas where vehicles must comply with standards such as Euro 6/VI for diesel and Euro 4/IV for petrol [5]. This approach not only accelerates the renewal of the vehicle fleet within the area but also incentivises vehicle owners to adopt cleaner technologies, either by upgrading to newer, less polluting vehicles or by retrofitting their current ones with emissions-reducing technologies like diesel particulate filters.

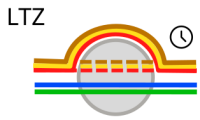
2.2.5. Congestion Charging / Urban Toll Schemes (CS)



Congestion Charging and Urban Toll Schemes (CS) are urban vehicle access regulations designed to manage traffic flow and reduce congestion in designated areas, particularly during peak hours, and based on pricing. By imposing a fee on drivers who enter or travel within these areas, these schemes aim to discourage the use of private vehicles and encourage the adoption of alternative transportation modes such as public transit, cycling, and walking. The fees serve as a financial disincentive for driving during busy times, thereby reducing traffic volume, mitigating congestion and promotes more efficient and sustainable urban mobility in the (peri-)urban area.

A combination of measures within these schemes can also address both congestion and pollution. For instance, a pollution zone requires vehicles that do not meet specific emission standards to pay a certain fee, whereas compliant vehicles can enter for free. A congestion charge zone typically charges all motor vehicles, though there may be differential charges based on vehicle type and emission levels, as seen in cities like Oslo, Tokyo and Seoul [6] [8].

2.2.6. Limited Traffic Zones (LTZ)



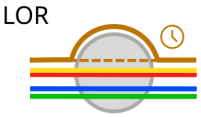
Limited Traffic Zones (LTZ) are spatial areas where vehicle traffic volume is intentionally kept low through access restrictions imposed by local municipalities. In LTZ, vehicle entry is restricted to specific groups, such as residents, authorized deliveries, and essential services (i.e. health emergencies, etc.). Pedestrians and cyclists often have priority within these areas. The primary objectives of LTZ align with those of pedestrian zones: improving liveability, enhancing road safety, protecting cultural and natural heritage, and mitigating climate impact. LTZ aim to reduce congestion by allowing only motorised trips deemed necessary for the functioning and daily life of the area, meaning that contrary to Pedestrian zones, LTZ strike a balance in motorised vehicle access. LTZ typically introduce a permit system where various categories of pre-registered users are granted access. Vehicles like public transport, taxis, and emergency/police vehicles are clearly marked and automatically allowed access. An example of LTZ implementation is Barcelona's Superblocks, which restrict traffic to create car-free or car-light zones, promoting sustainable urban mobility [7].

2.2.7. Emergency Air Pollution Schemes (EAP)

Emergency air pollution schemes are temporary vehicle access restrictions implemented in response to acute air pollution episodes. These events typically occur during episodes of high pollution levels, posing risks to public health. When pollution levels exceed safe thresholds, authorities activate emergency measures to mitigate the impact.

Restrictions may vary according to the severity of the pollution and local conditions. Examples include temporary bans on specific vehicle types, especially those with high emissions. Moreover, such temporal emergency schemes are often applied during peak pollution peaks in urban areas that already apply LEZ. This is the case of Paris, Brussels, Lyon, Grenoble, Berlin, Stuttgart, Antwerp, Ghent, Madrid, Milan, Amsterdam, and Seoul [4].

2.2.8. Lorry Bans/Delivery Time Windows (LOR)

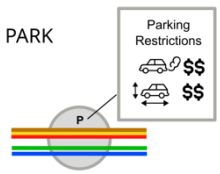


Heavy vehicle Bans and Delivery Time Windows are regulatory measures implemented to manage the access to infrastructure of heavy goods vehicles (lTrucks) to urban areas. These schemes typically restrict or schedule the times when trucks can enter certain zones, aiming to alleviate congestion, reduce noise levels, and enhance air quality during specific hours [3].

As part of an overall urban mobility strategy, these LORs are often combined with other types of urban HGV traffic management schemes (loading/unloading permits, dedicated lanes, and time-restricted operations to ensure efficient use of limited road space while accommodating the needs of businesses and residents alike). Other restrictions may include night-time delivery bans, designated delivery hours in city centres, and specific zones where heavy goods vehicles are only

permitted during off-peak hours to optimize traffic management and environmental outcomes. Note that in practice, LORs play an essential role in urban logistics by regulating not only access to road infrastructure and timetables but also access to public space and sidewalks used for heavy vehicle freight operations.

2.2.9. Parking Schemes (PARK)



Parking schemes can be considered as UVARs when they regulate vehicle access in an urban area according to specific conditions such as price, size, emission levels or status of visitors' and resident's vehicles. This type of restrictive measure linked to vehicle-based parking charges has a direct impact on vehicle access to the restricted area and its infrastructure.

In the context of the UVAR, these schemes generally involve Restricted Parking Zones or specific rules on vehicle access to parking in designated areas. Although traditionally seen as a supporting measure, parking regulation plays an essential role in complementing wider UVAR strategies by ensuring the efficient allocation of limited urban infrastructure space.

[1] European Commission Staff Working Document. (2013). *Access Regulations*. Brussels: European Commission.

[2] Graziani, A. (2020). Analysis of UVAR Frameworks. *Journal of Urban Mobility Studies*, 45(3), 134–150.

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[7] Muñoz, M. (2020). Evaluation of Barcelona's Superblocks. *Urban Planning Journal*, 33(4), 87–98.

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3. METHODOLOGY

3.1. OVERVIEW

The work to produce this collection of case studies was conducted in successive stages:

- **LITERATURE REVIEW**: firstly, after exploring the state of the art, WG2.1.2 carried out a literature review with 50 references from 22 PIARC 2.1 members, then set the UVAR typologies that were significant according to the terms of reference (APPENDIX 2). This stage took place between March and July 2024.
- **CASE STUDIES**: secondly, during a meeting held on July 2024, the WG proposed and discussed the case study collection form (ANNEX 1). This form would include a standard recto-verso A4 fact sheet. The aim was to collect as many case studies as possible from around the world. This took place between July 2024 and December 2024. The reason for adopting this method is to involve as many members as possible to get significant and relevant worldwide case studies. Moreover, this straightforward collection of case studies through simplified fact sheets allowed the members to share their national UVAR case studies.

As illustrated in *ANNEX 1*, emphasis was put on understanding the UVAR schemes at play, its background, its elements, the complementary measures that were taken, the results, the success factors, the potential neglected effects, as well as the outlook of the UVAR policy or scheme (i.e. planned developments, expansions, updates, or adjustments). Then, the potential for the transferability of the measure to other (peri-)urban areas was also interrogated.

3.2. IS A MEASURE OR SCHEME AN UVAR?

From July 2024, the WG progressively collected case studies and commented on their content in order to improve their quality. To facilitate a consistent approach to writing case studies, guidelines were prepared, presented at the various meetings and circulated to all members. These are set out in APPENDIX 3. In addition, when requesting members to participate in the collection of case studies, an example of a completed information sheet was attached to serve as a template.

Steps to Assess if a Measure is a UVAR:

1. Identify the Targeted Urban Challenges: Determine whether the measure addresses issues like air pollution, congestion, noise, or accessibility.
2. Analyse Access Conditions: Evaluate if access is regulated based on criteria such as vehicle type, emissions, fees, or specific timeframes.
3. Examine Enforcement Mechanisms: Confirm the existence of regulatory frameworks, such as fines or permits, to enforce compliance.
4. Evaluate Policy Integration: Assess how the measure fits into broader urban strategies and aligns with mobility or environmental goals.
5. Assess Temporal and Spatial Scope: Consider whether the measure applies to specific zones or times, and if its scope evolves based on urban needs.
6. Measure the Impact: Analyse the quantifiable environmental, social, and economic effects of the regulation.

Importantly, UVAR is understood here as a broad and evolving umbrella concept, adaptable to varying urban contexts and governance capacities—including those in middle- and low-income countries. UVARs are often implemented in phased stages, and their spatial coverage, associated measures (e.g. push & pull strategies), and regulatory intensity may evolve over time in response to local priorities and technological innovations.

4. RESULTS OF UVAR CASE STUDY COLLECTION

The aim of this chapter is to present the complete set of Urban Vehicle Access Regulations (UVARs) examples collected during the study period. Submitted from all over the world, these case studies present a wide variety of approaches, whilst they all provide useful lessons and examples, they may not all be suitable for every circumstance – some may be applicable to a particular set of local circumstances. The different classifications of the case studies allow readers to access the necessary information quickly and form a clear understanding of the UVARs projects and the major benefits achieved.

4.1. LIST OF CASE STUDIES

The table below lists the examples of Urban Vehicle Access regulations (UVAR) cases studies collected. It shows the name, type of practice, country and city of the project.
Types of Urban Vehicle Access Regulations:

a) Low Emission Zones, Zero Emission Zones, Ultra Low Emission Zones (LEZ/ZEZ/ULEZ)
b) Limited and Low Traffic Zones (LTZ)
c) Congestion Charging and Urban Tolls (CS)
d) Pedestrian Zones (PED)
e) Parking Zones (PARK)
f) heavy vehicle Bans and Delivery Time Windows (LOR)
g) Emergency Air Pollution Schemes (EAP)

In total, 29 cases were collected. The table below lists by country, title (name), city (urban area), type (UVAR type).

Table 1: List of UVAR case studies collected

	Country	Title	City	Type
1	*China*	*Beijing Low Emission Zone*	*Beijing*	*LEZ*
2	*Belgium*	*Brussels Low Emission Zone*	*Brussels*	*LEZ*
3	*France*	*Lyon Low Emission Zone*	*Lyon*	*LEZ*
4	*Italy*	*Padua Low Emission and Traffic Zone*	*Padua*	*LEZ*
5	*South Africa*	*Johannesburg Vehicle Emissions Control*	*Johannesburg*	*LEZ*
6	*Belgium*	*Antwerp Low Emission Zone*	*Antwerp*	*LEZ*
7	*Spain*	*Madrid Low Emission Zone*	*Madrid*	*LEZ*
8	*Spain*	*Barcelona Low Emission Zone*	*Barcelona*	*LEZ*
9	*United Kingdom*	*London Ultra Low Emission Zone*	*London*	*LEZ*
10	*Slovenia*	*Maribor Limited Traffic Main Square*	*Maribor*	*LTZ*

	Country	Title	City	Type
11	Belgium	Brussels School Streets	Brussels	LTZ
12	Spain	Vitoria-Gasteiz Superblocks	Vitoria-Gasteiz	LTZ
13	Mayotte	Mamoudzou Alternating Traffic Restrictions	Mamoudzou	LTZ
14	Argentina	Buenos Aires Center Environmental Area	Buenos Aires	LTZ
15	South Korea	Seoul Congestion Charging Scheme	Seoul	CS
16	Japan	Kawasaki Environmental Road Pricing	Kawasaki	CS
17	Romania	Timișoara Pedestrian-friendly City Center	Timișoara	PED
18	France	Nantes Pedestrian Zone	Nantes	PED
19	Belgium	Mechelen Pedestrian Commercial Street	Mechelen	PED
20	Tunisia	Medina of Tunis	Tunis	PED
21	Canada	Québec Parking Scheme	Quebec City	PARK
22	France	Lyon Parking Pricing Scheme	Lyon	PARK
23	France	Strasbourg Delivery LEZ	Strasbourg	LOR
24	Romania	Timisoara Drop-off points	Timișoara	LOR
25	Romania	Timisoara's Heavy Vehicle Access Scheme	Timisoara	LOR
26	Morocco	Freight Distribution and Access in Fez	Fez	LOR
27	Belgium	Ghent's Lorry Access Regulations	Ghent	LOR
28	Morocco	Casablanca Lorry Lanes	Casablanca	LOR
29	Belgium	Brussels Air Emergency LEZ	Brussels	EAP

Table 2: Characteristics of the urban areas of the UVAR case studies collected

Case Co	Case Study	Country	City	Latitu	Longitu	Typ	City Pop	Country Po	GDI per cap (U	GDP (Million US
LEZ-1	Beijing Low Emission Zone	China	Beijing	39,9042	116,407	LEZ	21540000	1412000000	12720	17963000
LEZ-2	Brussels Low Emission Zone	Belgium	Brussels	50,8503	4,3517	LEZ	1850000	11500000	52350	599600
LEZ-3	Lyon Low Emission Zone	France	Lyon	45,75	4,85	LEZ	1748000	68000000	44510	3042000
LEZ-4	Padua Low Emission and Traffic Zone	Italy	Padua	45,4064	11,8768	LEZ	210000	59000000	37920	2110000
LEZ-5	Johannesburg Vehicle Emissions Control	South Africa	Johannesburg	-26,2041	28,0473	LEZ	5580000	60000000	6830	399000
LEZ-6	Antwerp Low Emission Zone	Belgium	Antwerp	51,2194	4,4025	LEZ	530000	11500000	52350	599600
LEZ-7	Madrid Low Emission Zone	Spain	Madrid	40,4168	-3,7038	LEZ	3323000	47400000	39040	1624000
LEZ-8	Barcelona Low Emission Zone	Spain	Barcelona	41,3874	2,1686	LEZ	1637000	47400000	39040	1624000
LEZ-9	London Ultra Low Emission Zone	United Kingdom	London	51,5074	-0,1278	LEZ	8982000	67000000	46780	3283000
LTZ-1	Maribor Limited Traffic Main Square	Slovenia	Maribor	46,5547	15,6459	LTZ	96000	2100000	30980	67900
LTZ-2	Brussels School Streets	Belgium	Brussels	50,8503	4,3517	LTZ	1850000	11500000	52350	599600
LTZ-3	Vitoria-Gasteiz Superblocks	Spain	Vitoria-Gasteiz	42,8467	-2,6716	LTZ	253000	47400000	39040	1624000
LTZ-4	Mamoudzou Alternating Traffic Restrictions	Mayotte	Mamoudzou	-12,7827	45,2288	LTZ	71000	310000	9160	310000
LTZ-5	Buenos Aires Center Environmental Area	Argentina	Buenos Aires	-34,6037	-58,382	LTZ	3076000	45600000	10920	641000
CS-1	Seoul Congestion Charging Scheme	South Korea	Seoul	37,5665	126,978	CS	9733509	51700000	36810	1806000
CS-2	Kawasaki Environmental Road Pricing	Japan	Kawasaki	35,5308	139,704	CS	1540000	125000000	40240	4137000
PED-1	Timişoara Pedestrian-friendly City Center	Romania	Timişoara	45,7489	21,2087	PED	319000	19100000	17410	370000
PED-2	Nantes Pedestrian Zone	France	Nantes	47,2184	-1,5536	PED	320000	68000000	44510	3042000
PED-3	Mechelen Pedestrian Commercial Street	Belgium	Mechelen	51,0259	4,4777	PED	87000	11500000	52350	599600
PED-4	Medina of Tunis	Tunisia	Tunis	36,8065	10,1815	PED	1056000	12200000	3960	49300
PARK-1	Québec Parking Scheme	Canada	Quebec City	46,8139	-71,208	PARK	549000	39000000	59530	2263000
PARK-2	Lyon Parking Pricing Scheme	France	Lyon	45,75	4,85	PARK	1748000	68000000	44510	3042000
LOR-1	Strasbourg Delivery LEZ	France	Strasbourg	48,5734	7,7521	LOR	290000	68000000	44510	3042000
LOR-2	Timisoara Drop-off points	Romania	Timişoara	45,7489	21,2087	LOR	319000	19100000	17410	370000
LOR-3	Timişoara's Heavy Vehicle Access Scheme	Romania	Timişoara	45,7489	21,2087	LOR	319000	19100000	17410	370000
LOR-4	Freight Distribution and Access in Fez	Morocco	Fez	34,0181	-5,0078	LOR	1112000	37000000	3890	142000
LOR-5	Ghent's Lorry Access Regulations	Belgium	Ghent	51,0543	3,7174	LOR	265000	11500000	52350	599600
LOR-6	Casablanca Lorry Lanes	Morocco	Casablanca	33,5731	-7,5898	LOR	3369800	37000000	3890	142000
EAP-1	Emergency LEZ in Brussels	Belgium	Brussels	50,8503	4,3517	EAP	1850000	11500000	52350	599600

Data sources:

- GDP (million USD): World Bank national accounts data, and OECD National Accounts data files (2022)
- Country population: World Bank population estimates and projections (2022) City population: Official city statistics, OECD Metropolitan Database, World Population Review (2022–2023), local government data
- City coordinates (latitude-longitude) : Google Maps, GeoNames, and Wikipedia city pages (2023)
- City size classification: inspired by OECD, UN-Habitat, Eurostat classification

4.2. CLASSIFICATION OF CASE STUDIES

In this section, the case studies are classified based on parameters including continent, country, city, number of inhabitants, type of UVAR, occurrences of positive impacts and neglected costs, GDP, GDI per capita.

The analysis presented in this chapter is based on a collection of 29 UVAR case studies; however, it is important to acknowledge certain interpretative limitations. The dataset exhibits a strong European bias, with most case studies originating from European contexts and reflects a prevailing policy focus on air quality improvement and emissions reduction. As a result, other potential objectives of UVARs—such as social inclusion, public space reallocation, or the promotion of sustainable urban mobility in a broader sense—are less prominently represented. This bias is partly attributable to the current global distribution of UVAR initiatives, but also to the availability and emphasis of documented experiences. Therefore, while the findings provide important insights into existing practices, they should be interpreted with caution, recognizing the geographic and thematic scope of the collected material.

Table of figures

Country

In total, 29 case studies have been collected, originating from **16 different countries**. While the compilation includes examples from all continents, the distribution is not balanced. Europe is significantly overrepresented, with 7 countries contributing a total of 19 case studies. In comparison, Asia is represented by 3 countries, Africa by 4, and the Americas by 2 (one from North America and one from South America). Nevertheless, the collection offers a satisfactory representation of countries worldwide.

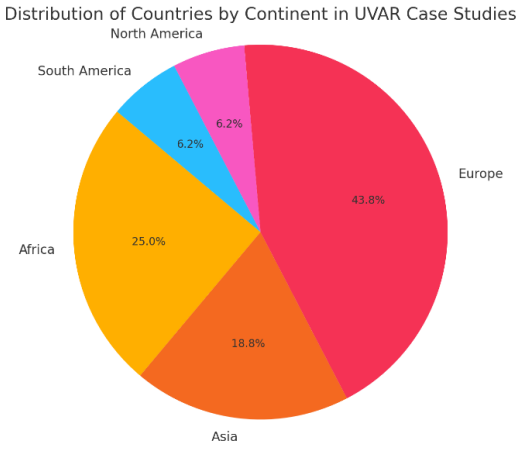


Figure 1 : Distribution of countries by continent

The map below illustrates the geographical diversity of the collection:

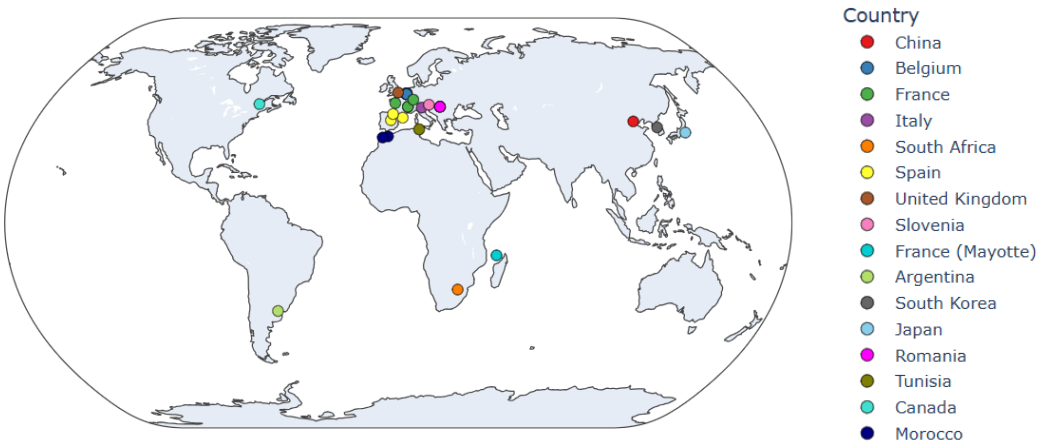


Figure 2 : World map with case studies locations

Number of inhabitants

The 29 case studies collected for this report span a diverse range of urban contexts in terms of city population size. Based on international classifications (OECD, UN-Habitat, Eurostat), the majority of UVARs have been implemented in large cities (1 to 5 million inhabitants), which account for over one-third of the cases. These are followed by medium-sized cities (250,000 to 1 million), small cities (50,000 to 250,000), and mega-cities with more than 5 million inhabitants. In contrast, only a few cases were reported from (smaller) cities, indicating that UVARs are currently more prevalent in cities where traffic congestion, pollution, and public health concerns are more acute. Moreover, this distribution could also reflect the administrative and financial capacity often required to design, implement, and enforce such schemes.

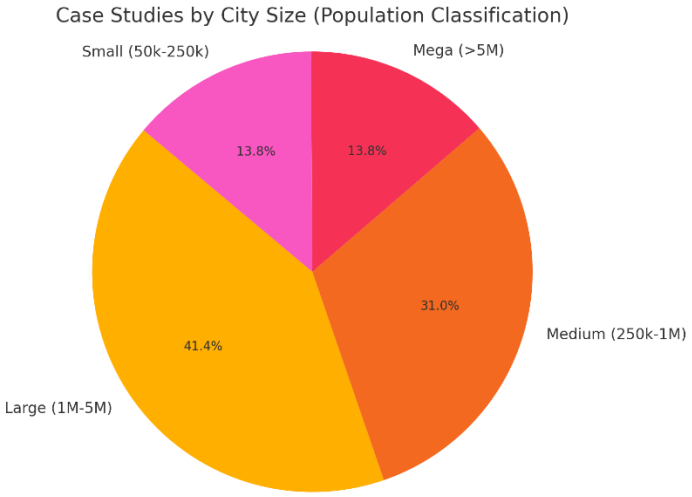


Figure 3: Classification of case studies by number of city inhabitants

UVAR typology

The graphs below indicate the type of Urban Vehicles Access Regulations. Note

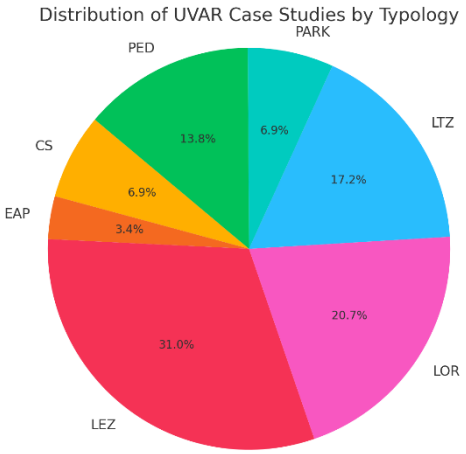


Figure 4 : UVARr case study typology distribution

The distribution of the 29 UVAR case studies collected reflects a strong predominance of Low Emission Zones (**9 LEZ**), which account for nearly one-third of the total. Limited Traffic Zones (**5 LTZ**) and Lorry Access Regulations (**6 LOR**) also represent significant shares, followed by Pedestrian Zones (**4 PED**), Congestion Charging Schemes (**2 CS**), Parking Regulations (**2 PARK**), and single Emergency Air Pollution measures (**1 EAP**). This typological spread shows a clear orientation of the collected UVAR policies toward regulating emissions and managing access for environmental and public health objectives, with less emphasis placed on congestion charging or dynamic parking management schemes.

4.3. CHARACTERISTICS OF FACTSHEETS

This section analyses different characteristics of the UVAR case studies collected.

Impacts and benefits

The bar chart below highlights the main benefits of the case studies collected. For each case study we noted the occurrences of the positive impacts based on the literature review classification of positive objectives and impacts of UVARs.

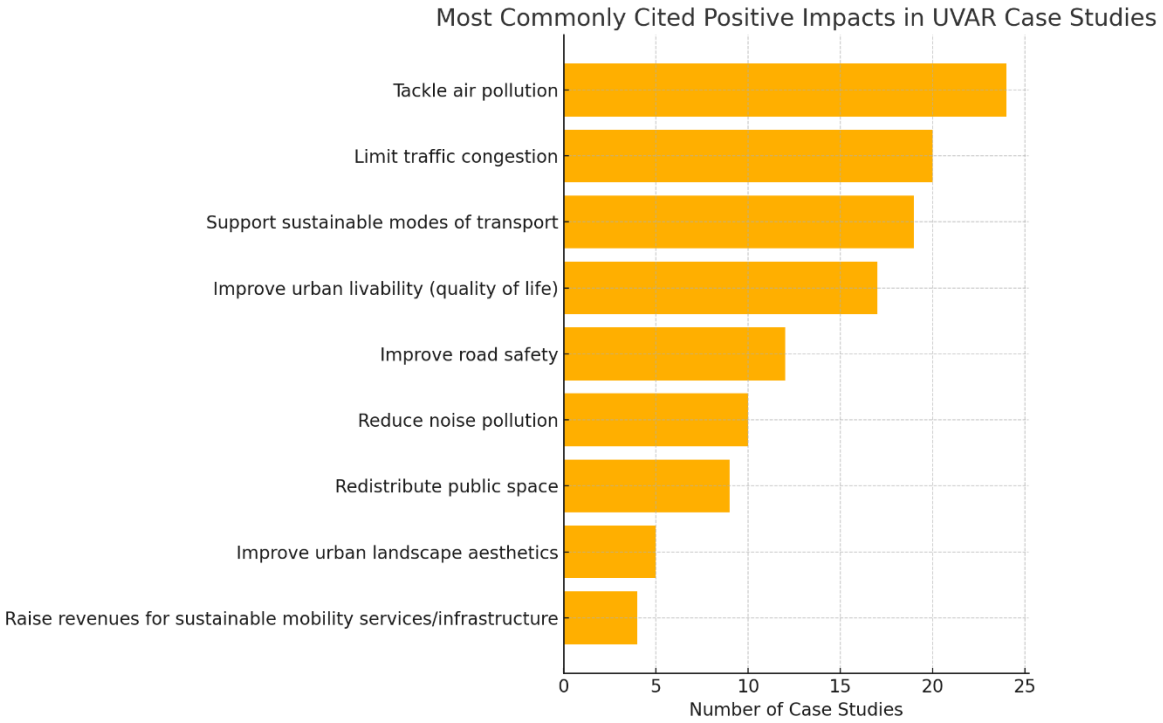


Figure 5 : Occurrences of positive UVAR impacts in the UVAR factsheets

The analysis of the 29 UVAR case studies reveals that the most cited positive impact is tackling/reducing air pollution, mentioned in 24 cases, underscoring a clear emphasis on environmental health. This is followed by limiting traffic congestion (20 cases) and supporting sustainable modes of transport (19 cases), reflecting the strategic role of UVARs in facilitating modal shift and reducing reliance on private vehicles. Improving urban liveability (17 cases) also emerges as a key goal, linking mobility regulation to broader quality-of-life outcomes.

Further frequently cited benefits include improving road safety (12 cases) and reducing noise pollution (10 cases), both of which contribute to public health and urban comfort. Comparatively less common, though still relevant, are objectives such as redistributing public space (9 cases), improving urban landscape aesthetics (5 cases), and raising revenues for sustainable mobility services and infrastructure (4 cases). These figures suggest that while environmental and mobility concerns dominate UVAR policy rationales, spatial and fiscal dimensions are less prominently integrated into current implementations.

Neglected costs

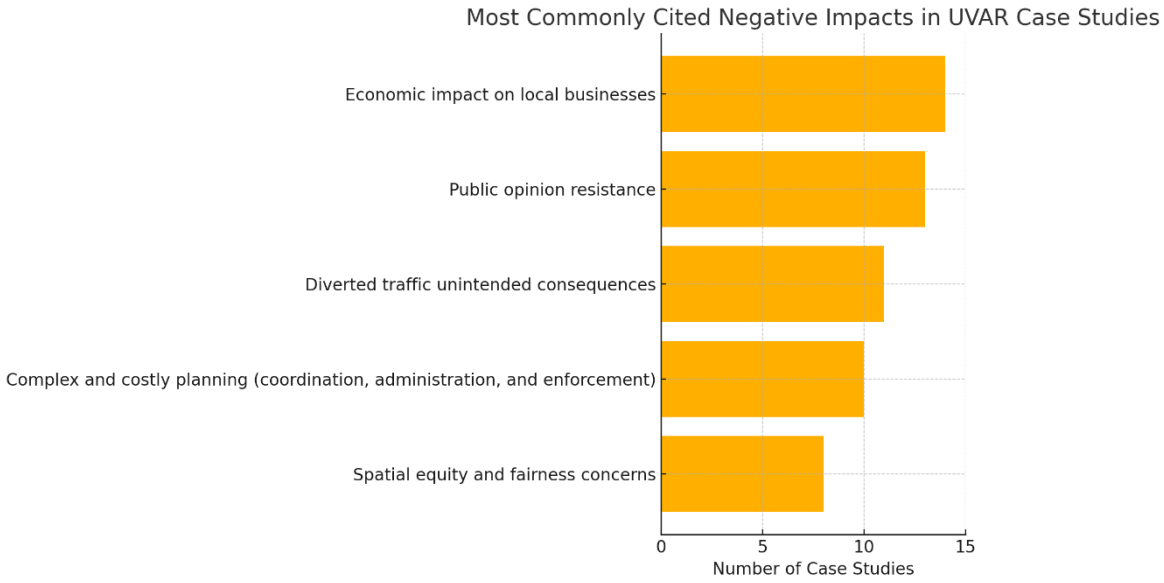


Figure 6 : Occurrences of negative UVAR impacts in the UVAR factsheets

The analysis of the 29 UVAR case studies, illustrated in the bar chart above, reveals a set of frequently cited negative impacts and neglected costs that can undermine the success of urban access regulation schemes. The most commonly reported challenge is the economic impact on local businesses, mentioned in 14 cases. This concern is particularly prevalent in city centres where retail and hospitality sectors depend on car-based access and footfall.

Public opinion resistance follows closely, cited in 13 cases, reflecting the sociopolitical sensitivity of implementing restrictive measures. These objections often emerge during the early phases of enforcement and can be mitigated through proactive communication and stakeholder engagement strategies.

Unintended consequences from diverted traffic, including increased congestion and pollution in surrounding areas, were highlighted in 11 cases. These spatial spillover effects illustrate the importance of integrating UVARs into broader, multimodal urban mobility plans.

Complex and costly planning, coordination, and enforcement were noted in 10 cases, underlining the administrative burden that UVARs can impose—especially for municipalities with limited technical capacity or fragmented governance structures.

Finally, spatial equity and fairness concerns were identified in 8 case studies. These include the disproportionate burden placed on lower-income households or residents in peri-urban areas who face greater difficulty complying with vehicle restrictions or lack viable mobility alternatives.

Overall, while UVARs offer substantial environmental and mobility benefits, the evidence suggests that their long-term success hinges on the early identification and mitigation of these secondary effects, particularly through inclusive planning, targeted support measures, and adaptive governance.

Gross Domestic Product

The pie chart below, shows the results of the collection by gross domestic product.

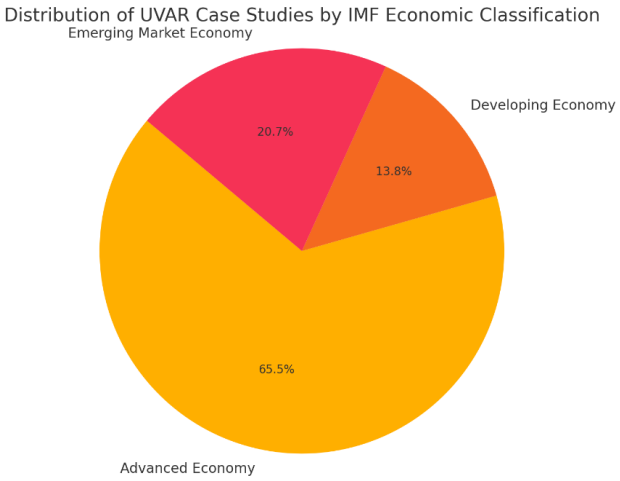


Figure 7 : GDP distribution

The analysis of the 29 UVAR case studies using the IMF economic classification shows a strong concentration in advanced economies. Of all cases, **19 (66%)** were implemented in advanced economies, **6 (21%)** in emerging market economies, and **4 (14%)** in developing economies. This distribution highlights that while UVAR strategies are predominantly developed and implemented in the world's most economically advanced regions, there is a growing presence of such measures in emerging and developing contexts, suggesting broader global applicability despite differences in administrative, financial, and technological capacities.

- 19 cases are from Advanced Economies (e.g., Belgium, France, Japan) : High-income countries with diversified economies and strong institutions
- 6 cases are from Emerging Market Economies (e.g., China, South Africa, Argentina, Romania) : Rapidly growing middle-income countries
- 4 cases are from Developing Economies (e.g., Tunisia, Mayotte, Morocco) : Lower-income countries facing structural challenges

Gross Domestic Income (GDP per capita)

The pie chart below, shows the results of the collection by national income group based on their GDP per capita.

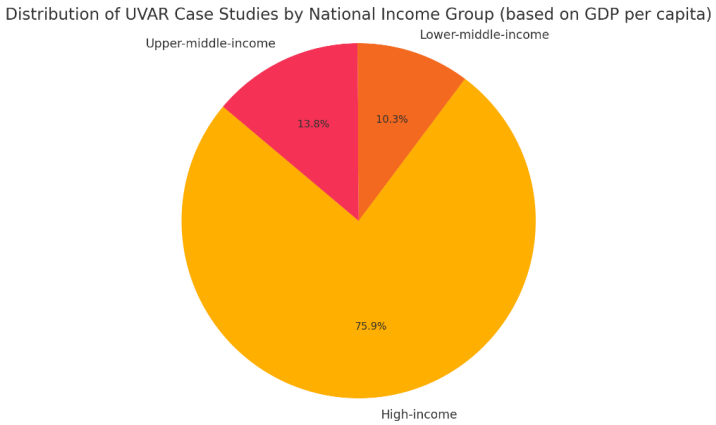


Figure 8 : GDI per capita distribution

Classification inspired by World Bank national data, and OECD National data (2022)

- **Low-income** : < 1 085 USD
- **Lower-middle-income** : 1 086 – 4 255 USD
- **Upper-middle-income** : 4 256 – 13 205 USD
- **High-income** : > 13 205 USD

The analysis of the 29 UVAR case studies, shown in the accompanying pie chart, reveals a strong concentration in high-income contexts. Out of all case studies collected, **22 (76%)** were implemented in countries classified as high-income based on GDP per capita, while **4 (14%)** were located in upper-middle-income countries, and **3 (10%)** in lower-middle-income countries. No case study was found in a low-income context.

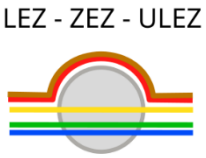
This distribution highlights the fact that UVARs are predominantly applied in wealthier nations, likely due to the greater administrative, financial, and technical capacity required for their successful planning, implementation, and enforcement.

5. CASE STUDY RESULTS

The 29 case studies below.

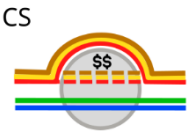
Low Emission Zones (LEZ)

1. BEIJING LOW EMISSION ZONE (CHINA)
2. BRUSSELS LOW EMISSION ZONE (BELGIUM)
3. LYON LOW EMISSION ZONE (FRANCE)
4. PADUA LOW EMISSION AND TRAFFIC ZONE (ITALY)
5. JOHANNESBURG VEHICLE EMISSIONS CONTROL (SOUTH AFRICA)
6. ANTWERP LOW EMISSION ZONE (BELGIUM)
7. MADRID LOW EMISSION ZONE (SPAIN)
8. BARCELONA LOW EMISSION ZONE (SPAIN)
9. LONDON ULTRA LOW EMISSION ZONE (UK)



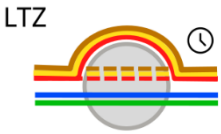
Congestion Charging and Toll Schemes (CS)

10. SEOUL CONGESTION CHARGING SCHEME (SOUTH COREA)
11. KAWASAKI ENVIRONMENTAL ROAD PRICING INITIATIVES (JAPAN)



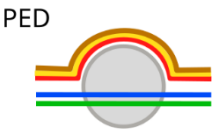
Limited Traffic Zones (LTZ)

12. MARIBOR LIMITED TRAFFIC MAIN SQUARE (SLOVENIA)
13. BRUSSELS SCHOOL STREETS (BELGIUM)
14. VITORIA-GASTEIZ SUPERBLOCKS (SPAIN)
15. ALTERNATING TRAFFIC RESTRICTIONS (MAYOTTE)
16. BUENOS AIRES CENTER ENVIRONMENTAL AREA (ARGENTINA)



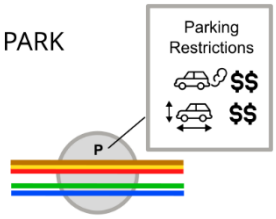
Pedestrian Schemes (PED)

17. TIMIȘOARA PEDESTRIAN-FRIENDLY CITY CENTER (ROMANIA)
18. NANTES PEDESTRIAN ZONE (FRANCE)
19. BRUUL PEDESTRIAN COMMERCIAL STREET (BELGIUM)
20. MEDINA OF TUNIS (TUNISIA)



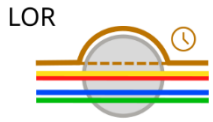
Parking Schemes (PARK)

21. QUÉBEC PARKING SCHEME (CANADA)
22. LYON PARKING PRICING SCHEME (FRANCE)



Lorry Bans & Delivery Time-Windows (LOR)

23. STRASBOURG DELIVERY LEZ (FRANCE)
24. TIMISOARA DROP-OFF POINTS (ROMANIA)
25. TIMIȘOARA'S HEAVY VEHICLE ACCESS SCHEME (ROMANIA)
26. URBAN FREIGHT DISTRIBUTION AND ACCESS IN FEZ (MOROCCO)
27. GHENT'S LORRY ACCESS REGULATIONS (BELGIUM)
28. CASABLANCA LORRY LANES (MOROCCO)



Emergency Air Pollution Schemes (EAP)

29. EMERGENCY LEZ IN BRUSSELS (BELGIUM)

GOOD PRACTICE FACT SHEETS

LEZ - ZEZ - ULEZ

5.1. BEIJING LOW EMISSION ZONE (CHINA)

Keywords: LEZ, air pollution, vehicle emission, Beijing

DESCRIPITON IN SHORT

This case study introduces Beijing's low emission zone (LEZ), which spatially and temporally regulates the access rights of passenger and freight vehicles with different emission standards and fuel types. Implemented since 2014, the primary goal of this policy is to reduce air pollution and alleviate traffic congestion within the city's main area, particularly inside the 5th Ring Road. The policy covers various vehicle categories based on emission standard, fuel type and the last digit of the license plate and imposes restrictions on high-emission vehicles, to improve the urban air quality and residents' living environment.

Beijing's Air Quality Improvement in Last 10 Years

BACKGROUND

Beijing, one of the world's most populous cities, has struggled with frequent heavy pollution for decades, largely due to vehicle emissions and rapid urbanization. Recent analysis shows that transportation account for 45% of local PM2.5 emissions, with trucks accounting for more than half of all vehicle emissions. To address frequent heavy pollution and urban congestion, the government introduces the LEZ with the following objectives:

- **Improve air quality:** The goal is to reduce vehicle pollutant emissions like $PM_{2.5}$, PM_{10}, NO_2 and SO_2 by restricting access of older and high-emission vehicles, leading to better air quality in Beijing.
- **Reduce traffic congestion:** Limit the number of vehicles on the road, especially during peak hours, through high-emission vehicle restrictions and odd-even policies, to ease congestion and improve traffic flow.
- **Protect public health:** Lower emissions lead to better air quality, reducing respiratory and cardiovascular health issues, and improving residents' overall well-being.

The LEZ policy was driven by national and regional policies, such as the Beijing Air Pollution Prevention Regulations, Beijing's 2013-2017 Clean Air Action Plan, 1 Microgram Action, and Beijing Blue Sky Protection Campaign. Beijing also introduced the Motor Vehicle and Non-Road Mobile Machinery Emission Control Regulations, providing a strong legal basis for pollution control. These policies, combined with China's Five-Year Plans, laid the foundation for stricter emission standards and targeted measures for high-emission vehicles, ultimately leading to the LEZ.

Public awareness campaigns played a crucial role in gaining support for the LEZ. Beijing organized events like Energy Conservation Week and Low-Carbon Day to promote green lifestyles. These campaigns highlighted the health risks of air pollution and educated residents through various outreach methods.

ELEMENTS

The LEZ is designed to restrict vehicles based on their emission standards, fuel types and whether they are used for passenger or freight purposes. Exemptions are granted for pure electric vehicles, emergency vehicles, public transport, or specific zones/times. Applications are reviewed by authorities, and decisions are communicated via public channels and apps, ensuring transparency. The key restrictions are summarized in the table below:

<table>
<tr><th>Vehicle Emission Standard</th><th>Gasoline Passenger Cars</th><th colspan="2">Diesel Trucks</th></tr>
<tr><td>China I / II</td><td>Restricted within 5th Ring Road, on weekdays.</td><td rowspan="2">Banned citywide, all day.</td><td rowspan="4">Restricted within 5th Ring Road (6:00 to 23:00).

Trucks of over 8 tons restricted on main roads within the 5th Ring Road.</td></tr>
<tr><td>China III</td><td rowspan="3">Odd-even vehicle ban (3:00 to 24:00) in heavy pollution.</td></tr>
<tr><td>China IV</td><td>Citywide restrictions in heavy pollution.</td></tr>
<tr><td>China V and above</td><td>Odd-even vehicle ban (3:00 to 24:00) in heavy pollution.</td></tr>
<tr><td>Zero Emission</td><td>No restrictions</td><td>No restrictions</td><td></td></tr>
</table>

RELATED MEASURES

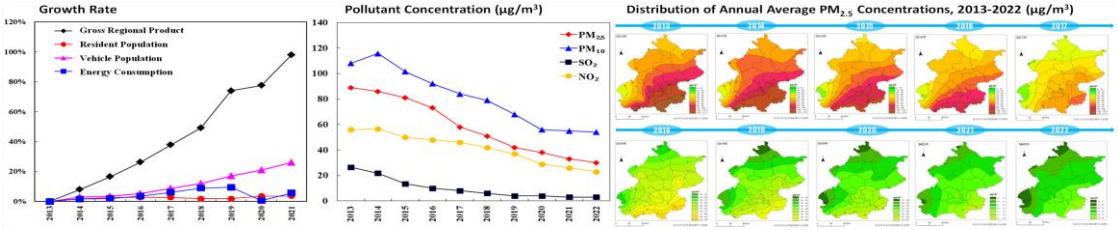
In addition to the emission-based restrictions, Beijing has implemented several complementary initiatives to support the overall goals of reducing air pollution and traffic congestion:

- **High-Emission Vehicle Scrappage Incentives:** The Government provides financial incentives of up to RMB 140,000 for scrapping old trucks and buses below the China IV emission standard and has joined hands with 12 vehicle manufacturers to offer 355 discounted models.
- **Electric Vehicle Purchases Incentives:** Beijing provides incentives for purchasing electric vehicles, including financial subsidies and vehicle tax reduction.
- **Developing Public Transportation:** Beijing has 27,600 buses and 1,633 bus lines, with a total length of 42,726 kilometers. Public transport has reached 52.9% of motorized trips since 2023.
- **Public Awareness Campaigns:** Beijing organized over 200 seminars to advocate low-carbon lifestyles and involve citizens in shared traffic management.

IMPACTS, BENEFITS, NEGLECTED COSTS

The LEZ has had a noticeable impact on the city's air quality. Since its implementation, Beijing has seen a measurable decline in pollutant concentration. Compared with 2013, $PM_{2.5}$, PM_{10}, NO_2, and SO_2 decreased by 66.5%, 50.0%, 58.9%, and 88.7%, respectively, in 2022. In terms of spatial characteristics, from 2013 to 2022, $PM_{2.5}$ concentrations in all regions of Beijing continued to decline, with the gap between north and south concentrations narrowing from 63 μg/m³ in 2013 to 16 μg/m³ in 2022.

However, some adverse effects have been noted, particularly in peri-urban areas outside the 5th Ring Road, where restricted vehicles tend to accumulate, leading to localized congestion and pollution.



SUCCESS OR FAILURE FACTORS

The success of Beijing's LEZ can be attributed to several key factors. For other cities adapting the LEZ, implementation should be gradual, starting with small-scale trials and adjusting based on feedback and outcomes, which can reduce implementation resistance and allow for optimization based on real-world conditions.

- **Encouraging the early phasing out of high-emission vehicles**: A total of more than 2.36 million old motor vehicles have been phased out, and the elimination of 95,000 China III gasoline vehicles can reduce emissions of CO, NO_X, HC, PM, and other pollutants by about 0.8 million tons per year.
- **Promoting the purchase and usage of new-energy vehicle**: More than 580,000 new-energy vehicles have been promoted through policies such as purchase subsidies and unlimited driving for electric vehicles, and the proportion of new-energy vehicles and motor vehicles with a China V or above has exceeded 70%.
- **Technological Integration**: The use of advanced monitoring technologies, such as Automated Number Plate Recognition (ANPR), was crucial for enforcement.

OUTLOOK & TRANSFERABILITY

Beijing has implemented Beijing's Online Vehicle Emission Monitoring Platform. The platform enables real-time monitoring of traffic data, vehicle positioning, traffic energy consumption and emissions, trend analysis, and data sharing with key enterprises to improve their energy management. The platform also analyzes driver behavior, providing personalized training to reduce energy consumption and emissions. This approach has helped Beijing set specific targets for energy conservation and emissions reduction in transportation planning.

Beijing's Vehicle Emission Monitoring Platform

Transferability of LEZ policy depends on establishing similar monitoring systems, fostering cooperation between transportation departments, environmental authorities, and vehicle companies, and providing fair economic incentives for vehicle replacement to ensure effectiveness. For regions with fewer resources, starting with low-cost monitoring solutions (like mobile application), community engagement, and encouraging regional cooperation to share resources and experiences is crucial before scaling up to ensure effectiveness and equity.

MORE INFORMATION
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Author: Gaoqiang ZHANG - TC 2.1.2 PIARC member **05.12.2024, Version 2**

GOOD PRACTICE FACT SHEETS

LEZ - ZEZ - ULEZ

5.2. BRUSSELS LOW EMISSION ZONE (BELGIUM)

Keywords: LEZ, congestion mitigation, air pollution, Brussels

DESCRIPTON IN SHORT

Brussels has implemented a Low Emission Zone (LEZ) as part of its efforts to improve air quality. It aims to achieve a progressive **complete phase-out of combustion engines by 2035-2036** by restricting the entry of vehicles that do not meet certain emission standards. Only vehicles that meet the specified Euro emission standards or that have a day pass are allowed to enter the Brussels Capital Region zone without facing fines.

The LEZ is part of broader efforts to improve air quality and reduce noise pollution, contributing to EU's climate objectives and the Brussels region's transition to a sustainable city-region.

BACKGROUND

Since January 1, 2018, the Brussels-Capital Region has been designated a Low Emission Zone (LEZ) to tackle air quality and public health challenges. The LEZ restricts access for the most polluting vehicles, applying to cars (category M1), vans (category N1), (mini-)buses, and coaches (categories M2 and M3), whether registered in Belgium or abroad. Access depends on the vehicle's fuel type and Euro standard, which is a proxy for its age and emission profile.

The LEZ was introduced in response to persistently poor air quality in Brussels, where **NO_2 levels** have exceeded European Union limits. These emissions are linked to a high rate of respiratory illnesses and cardiovascular conditions among residents. Additionally, road traffic is a significant source of **30% of CO_2 emissions** and noise pollution in the city, making it a critical target for emission reduction policies.

Initial restrictions banned diesel vehicles registered before 2001 (Euro 2) and gasoline vehicles registered before 1997 (Euro 1). The criteria have gradually tightened, and by 2022, Euro 4 diesel and Euro 2 gasoline vehicles were no longer permitted. The LEZ continues to evolve, with the next major step being a ban on Euro 5 diesel vehicles, initially planned for 2025 but **extended** to 2027, providing residents more time to adapt to the transition.

Carburant		2025	2028	2030	2035	2036
Voiture (M1) Camionnette (N1, Klasse I)	Diesel/hybride	Euro 6	Euro 6d	⃠	⃠	⃠
	Essence/CNG/LPG	Euro 3	Euro 4	Euro 6d	⃠	⃠
Minibus (M2) Camionnette (N1, Klasse II, III)	Diesel/hybride	Euro 6	Euro 6d-TEMP	Euro 6d	⃠	⃠
	Essence/CNG/LPG	Euro 3	Euro 4	Euro 6d	⃠	⃠
Bus (M3, Klasse I, II, A)	Diesel/hybride	Euro VI	Euro VI	Euro VI	Euro VId	⃠
	Essence/CNG/LPG	Euro III	Euro IV	Euro VI	Euro VId	⃠
Autocar (M3, Klasse III, B)	Diesel/hybride	Euro VI	Euro VI	Euro VI	Euro VId	Euro VIe
	Essence/CNG/LPG	Euro VI	Euro VI	Euro VI	Euro VId	Euro VIe
Mobylette (L1-L2)	Diesel/hybride	⃠	⃠	⃠	⃠	⃠
	Essence/CNG/LPG	Tous	Euro 5	Euro 6	⃠	⃠
Moto (L3-L5)	Diesel/hybride	⃠	⃠	⃠	⃠	⃠
	Essence/CNG/LPG	Euro 3	Euro 4	Euro 5	⃠	⃠
Quadricycles (L6-L7)	Diesel/hybride	⃠	⃠	⃠	⃠	⃠
	Essence/CNG/LPG	Tous	Euro 4	Euro 5	⃠	⃠
Poids-lourd (N2-N3)	Diesel/hybride	Euro VI	Euro VI	Euro VId	Euro VIe*	Euro VIe*
	Essence/CNG/LPG	Euro III	Euro IV	Euro VId	Euro VIe*	Euro VIe*

* Uniquement pour N2 dont la masse de référence est supérieure à 2.610 kg et pour les N3

ELEMENTS

The Brussels LEZ is a regulatory framework that limits access for vehicles based on their Euro standard and fuel type. The LEZ has a dedicated website that informs users about the LEZ scheme (impact, boundaries, agenda, control, fines), the alternatives, the registration, the day pass, and the exceptions.

Control and Enforcement Techniques:

- **Automated Number Plate Recognition (ANPR)**: The LEZ's primary enforcement tool is an extensive network of 363 ANPR cameras. These cameras scan license plates at various entry points and key areas within the zone, cross-referencing with a database to identify vehicles that do not meet the emission criteria.
- **Fines**: Non-compliant vehicles detected by the ANPR system are subject to fines of €350 per offense, with a maximum of four fines per year per vehicle. This system incentivizes adherence to the rules while capping financial penalties to avoid excessive burden on vehicle owners.
- **Day Pass System**: Occasional access to the LEZ is possible through the purchase of day passes, which allow non-compliant vehicles to enter the zone up to **8 days per year**. This system is designed for visitors or occasional users who need temporary access without facing immediate fines.
- **Signage and Boundaries**: Nearly **300 road signs** mark the boundaries of the LEZ, ensuring drivers are aware when they enter or exit the regulated area. These signs are strategically placed at all entry points and key intersections around the Brussels-Capital Region to provide clear information to motorists.

Monitoring and Data Management:

- **Vehicle Registration Databases**: Compliance is verified using vehicle registration databases that contain details about the Euro standard and fuel type of each vehicle. This allows for accurate identification of non-compliant vehicles entering the zone.
- **Exemptions and Special Routes**: Specific access roads are exempt from LEZ restrictions, notably those leading **to Park and Ride** (P+R) facilities. This encourages drivers of non-compliant vehicles to use public transport, providing a smoother transition to cleaner travel options. Additionally, certain vehicle categories (e.g., emergency services, vehicles for people with disabilities) may be exempt under specific conditions.

RELATED MEASURES

The Brussels-Capital Region supports and strengthens the LEZ through several initiatives and plans:

- **Public Transport Investment**: Allocating nearly **20% of the regional budget** annually to enhance public transport services.
- **Bruxell'Air Premium**: Offers a **mobility budget** for residents who give up their cars, usable for **public transport, bicycles, or shared mobility (2092 premiums end 2022)**.
- **LEZ Premium for Small Enterprises:** Financial aid for micro and small businesses to replace older vehicles with **less polluting ones**.
- **EV Charging Infrastructure**: Expansion plans include **22,000 charging points by 2035**, with **4,000** already available, ensuring widespread access (2311 end 2022).
- **Transition Facilitators** provided tailored support to businesses and residents adapting to sustainable mobility.
- **Public Awareness Campaigns**: Ensuring residents understand LEZ regulations and available alternatives, with targeted support for **low-income groups**.
- **Low Emission Mobility Roadmap**: A strategic guide for **phasing out thermal vehicles** and transitioning to electric alternatives, aligning with long-term sustainability goals.
- The **LEZ websites offers guides and tools** to accompany users in need (alternatives, exemptions, day pass, vehicle replacement, etc.)

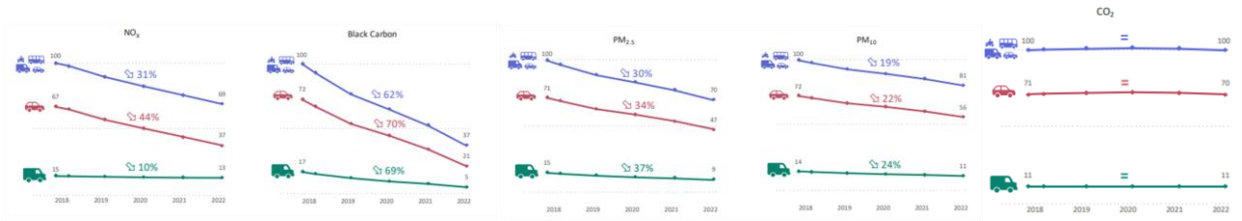
IMPACTS (Pros & Cons)

The Brussels Low Emission Zone (LEZ) has had both positive and negative impacts. On the positive side, it has significantly improved air quality by reducing harmful pollutants and has promoted the use of sustainable transport. This has led to health benefits for the city's residents. However, on the downside, the LEZ has financial implications for owners of high-emitting vehicles who need to upgrade their vehicles to comply with the rules. Moreover, air pollution remains a significant issue in Brussels, indicating that the LEZ alone may not be sufficient to solve the city's air pollution problem.

Environmental and health Impact: In the Brussels-Capital Region (RBC), exposure to PM2.5, NO2, and O3 in the air was estimated to cause 627, 323, and 19 premature deaths, respectively, in the year 2018. The LEZ has also led to substantial reductions in harmful pollutants.

Mobility Impact: As of 2023, **99% of vehicles** entering the LEZ were compliant, demonstrating effective adaptation among residents. As **7% of diesel vehicles** in the region (about **32,000 vehicles**) are affected by the 2025 phase-out, the extension will allow more time for users to adapt to the LEZ.

Economic Costs: The transition poses challenges for a minority of residents reliant on older diesel vehicles. For example, in 2022, **9.6% of day passes** were used by Brussels-registered vehicles, indicating a limited but present need for transitional solutions. Moreover, 54.5% of BCR residents do not own a car.



SUCCESS FACTORS

Success Factors:

- Strong investment in **public transport infrastructure** (20% of region's budget) has offered viable alternatives to car ownership.
- Financial incentives like the **Bruxell'air and LEZ premiums** have encouraged both individuals and businesses to adopt greener vehicles.
- Active **engagement with stakeholders**, including businesses and local communities, has facilitated smoother transitions in some cases.

Challenges:

- Addressing concerns from those who remain dependent on older vehicles, especially low-income households and neighborhoods.
- Ensuring the availability of sufficient and accessible charging infrastructure, particularly as more residents adopt electric vehicles.
- The politicization of the LEZ has led to delay of the 2025 phase to 2027.

OUTLOOK & TRANSFERABILITY

The comprehensive mix of regulatory measures and support programs makes Brussels a potential model for other world cities looking to implement LEZ. However, the implementation of such schemes would require customization to suit the unique conditions and requirements of each city. Moreover, the Brussels case teaches us that LEZ need to be flexible in their phasing and in their strategy to not leave vulnerable SMEs and residents without alternatives.

The outlook for the Brussels LEZ is positive with plans to tighten restrictions in 2027 and to phase out all internal combustion engine vehicles except for certain heavy-duty vehicles by 2035.

MORE INFORMATION

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21.02.2025, Version 2

PIARC

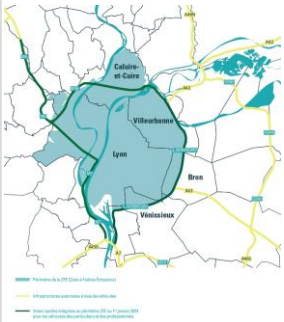
GOOD PRACTICES FACT SHEETS

LEZ - ZEZ - ULEZ

5.3. Lyon Low Emission Zone (FRANCE)

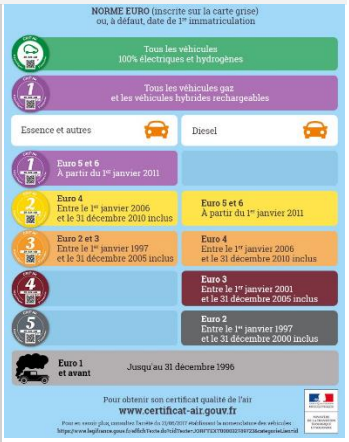
Keywords : [LEZ], [Air Quality] [vehicle renewal], [Air Quality litigation], [Modal shift]

DESCRIPTON IN SHORT



The Lyon metropolitan area introduced a Low Emission Zone (LEZ) in 2019. The vehicles targeted were heavy goods vehicles and light commercial vehicles on the agglomeration's territory inside its ring road, 24 hours a day, 7 days a week. The aim was to accelerate the renewal of the vehicle fleet and move as quickly as possible towards ambient air quality standards.

The timetable calls for the system to evolve, with the addition of new vehicles banned from traffic and parking, and a new perimeter made up of the major bypass roads. By 2028, the aim is to ban diesel vehicles (vehicles with certificate no. 2) from the central perimeter, and vehicles with certificate no. 3 from the main roads. [See relationship between French certificate and EURO standard].

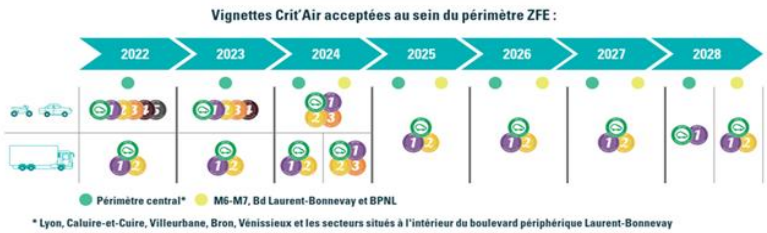


BACKGROUND

*[**National regulation of the LEZ-mobility in France.**: [The main reason for the introduction of the LEZ was a question of **air quality**: as the regulatory limit values for nitrogen oxides were not respected throughout the territory, populations were exposed. This gave rise to a legal dispute with the European Air Directive. French regulations therefore imposed the introduction of LEZ conurbations in this situation, i.e. a perimeter within which vehicle access is prohibited, depending on their pollutant emissions, based on Air Quality Certificates. The Mobility Orientation Law of 2019, followed by the Climate and Resilience Law of 2021, have led to an **obligation for 42 agglomerations** to set up a LEZ-m covering 50% of the population. The agglomeration chooses its own level of restriction. If air quality standards are exceeded, the restriction must at least concern Certificate °3 vehicles, ultimately by 2025. Generally speaking, agglomerations choose areas defined by major road infrastructures (rings). In 2024, **12 LEZ** are active, and 2 agglomerations still have regulatory exceedances].*

In Lyon, **the LEZ existed prior to the regulatory obligation**. The perimeter, based on a bypass infrastructure, was quickly chosen for practical reasons. The Municipality to the north joined the scheme by choice. This perimeter showed the highest population density, as well as the highest concentrations of pollutants. Large logistics sites, business parks and access roads to public transport relay parking lots were excluded from the perimeter. HGVs and LCVs were chosen as the initial target, as their ratio of number of km to quantity of pollutants emitted was more appropriate. These vehicles are mainly owned by professionals. In 2020, the political context, i.e. the election of an ecologist Mayor of Lyon and President of the Metropole, accelerated the project. Lyon's LEZ now targets motorized 2-wheelers and private vehicles.

ELEMENTS



Main features of the Lyon EPZ: Perimeter including the central area and the main bypass roads, 24/7 bans on traffic and parking and Vehicles subject to restrictions.
Examples of **vehicles not affected**: vehicles for the disabled, specialized vehicles, civil protection vehicles.
Examples of **temporary exemptions**: delivery deadlines for approved vehicles, 52 passages per year, refrigerated vehicles, recent vehicle acquisitions not complying with the 2028 constraint.
Implementation relies on vertical **signs**, on-street information (Variable Message Signs) and communication, as well **as support measures to help adapt professional and personal mobility practices** (mobility agency), and **financial aid** for modal shift and the purchase of compliant vehicles.
Controls are carried out by municipal police officers (parking controls) and national police officers (parking and traffic controls).
The deployment of automatic devices with license plate recognition is scheduled for 2026.

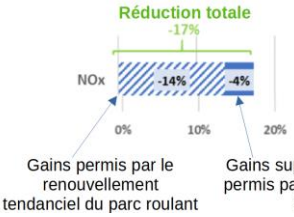
RELATED MEASURES

Other actions run in parallel with the LEZ or are intended as an alternative to the replacement of non-compliant vehicles. Traffic regulation measures such as speed reductions on major roads and urban areas (30km/h generalized), or the reallocation of road space for cycling, soft modes, public transport/carpooling and electric vehicles, or parking charges based on vehicle weight, all contribute to reducing the number of cars in the city.
The reinforcement of public transport lines and the development of urban logistics areas are designed to be consistent with the LEZ perimeter, in order to make the alternative behaviours identified upstream possible.

IMPACTS, BENEFITS, NEGLECTED COSTS

The impact study identified: a shift from non-compliant vehicles to alternative modes or compliant vehicles, accelerated fleet renewal, use of compliant vehicles inside and outside the regulated perimeter, lower pollutant emissions inside and outside the perimeter.
Evaluation after 3 years (HGVs and LCVs only) compares the HGV fleet by number plate recognition (actual fleet vs. modelled fleet at the same date), and indicates a drop in pollutant emissions.
Air quality is improving overall, but this is not linked to other effects of the LEZ (modal shift), nor to the effects of other mobility policies (car-sharing, cycling, etc.).
Regulations are still insufficiently controlled and sanctioned, so their effects are minimized.
Fears that the freedom to travel and work within the perimeter would be impeded, or that differences between sectors within and outside the perimeter would increase (gentrification), were noted during the consultation phases, but have not been quantitatively assessed on a metropolitan scale.

Evolution des émissions tous véhicules sur le périmètre ZFE entre 2018 et 2021, avec interdiction VUL/PL CQA3+ (Source Atmo AuRA)



SUCCESS or FAILURE FACTORS

Success factors: the LEZ is appropriate to the Lyon urban area, with a densely populated central city and alternative modes of transport, a clearly identifiable border route, concentration limit values exceeded and a contentious situation.
Success factors: ongoing exchanges between professionals and the urban area, and adaptation of financial aid schemes for vehicle purchases / Discussions around the 2028 constraint (end of diesel use): exemptions make it possible to keep a very recent, low-polluting vehicle = logic of sober consumption of new vehicles (cf. retrofit and circular economy).
Failure factors: partial compliance with regulations due to lack of controls; unsuitable public transport frequencies and technologies not yet deployed (cost-compliant vehicles, alternative energy refuelling network).
The system is being rejected for a number of reasons in a national context that minimizes the obligations of the 42 metropolitan areas: unfamiliarity with the system, ecological policies, a perceived congestion effect and an unfavourable local socio-economic context.

OUTLOOK & TRANSFERABILITY

The long-term vision for the Lyon LEZ is now assured, but the date of implementation of automatic control, which is essential, remains uncertain, due to the postponement of national obligations.
The initial French strategic vision, based on a network of 42 LEZ agglomerations, could have been a lever for improving the territory as a whole, slightly mitigating the perception of restriction on the individual. Indeed, France's dense agglomerations and extensive public transport network (major road infrastructures, old tramways and the legacy of “Haussmannian” hygienist urban planning) lent themselves well to the exercise of LEZ.
In France, however, LEZ are currently frowned upon, as the new coercive policies are seen as a restriction on freedom of movement. LEZ bring into focus the social position of the private car, and the social gaps between centre and periphery, even if this is unjustified in some cases. Misinformation, or partial information, is a major disadvantage of LEZs.
By 2023, some cities had abandoned this type of scheme. The network effect has therefore disappeared.

MORE INFORMATION

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21.02.2025, Version 2

GOOD PRACTICE FACT SHEETS

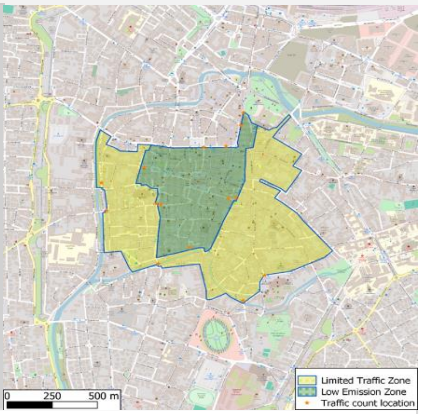
LEZ - ZEZ - ULEZ

5.4. Padua Low Emission and Traffic Zone (ITALY)

Keywords: Urban Vehicle Access Regulation, Low Emission Zone (LEZ), Sustainable mobility , Pollutant emissions ,Modal shift , Fleet renewal

DESCRIPITON IN SHORT

The Municipality of Padova is 92.8 square kilometers, with a resident population of approximately 210,000 inhabitants. Its Mobility Department is responsible for sustainable mobility planning, integrated mobility systems, access regulations, mitigation of traffic-related impacts on the environment. Padua has adopted a Sustainable Urban Mobility Plan (SUMP) that also embraces the 18 surrounding municipalities. The municipality created a new regulation managing vehicle access into the historic center, to promote the use of low emission (clean) vehicles. A Limited Traffic Zone (LTZ) has been enforced since 1989 in the central part of the city (about 0.95 km2), which includes the historic city center. A new and powerful system of electronic gates was implemented along the boundary of the LTZ.



BACKGROUND

The existing transportation network in Padova consists of two layers: the suburban network and the urban network. The former includes rail and road public transportation services that ensure an efficient connection of the city with the surrounding municipalities, as well as with other areas at the regional and national level. The urban transit network has 23 lines for road vehicles and one tramline. The latter connects the northern and southern parts of Padova through the historic city center, where there are 10 tram stops. The main mobility hub is located next to the train station, about 800-meters from the city center and represents the bus terminal of many suburban and urban lines. To promote the use of public transportation within the city, 6 park and ride facilities have been created along the boundary of the Municipality. The urban mobility planning culture moved from a set of different standalone planning tasks to an environmentally driven comprehensive planning approach to the city's transport policies. Workshops with municipal departments covering policy fields like the environment, public works, and trade as well as the local police and Padova University's department of civil, environmental and architectural engineering proved to be crucial. It was helpful to connect UVAR measures to environmental protection for public acceptance since the population is well aligned with the city's climate protection policy established 20 years ago. Understanding the specific needs or concerns of retail and residents improved the projects by fine- tuning plans accordingly. The Municipality has started to monitor the fine powder (PM10) from 2010. In the 2010 winter the PM10 limit value (50 µg/m3) has been exceeded more than 84 times. These data confirmed the classification of the Commune of Padova in the "A1 Provincial" zone (high pollution area).

ELEMENTS

Compliance of the users is ensured through an automatic control system installed at the entrances, and administrative fines for transgressors. Gates located along road sections accessing the LTZ are equipped with cameras that record vehicle license plate. In the area, the speed limit is set at 30 km/h. In line with the final goals of a LEZ, the access of vehicles in the area can be regulated considering their fuel type and emission standard. Only the following vehicle categories are likely to be authorized: electric, CNG, LPG Bifuel, CNG Bifuel, Petrol Hybrid or Diesel vehicles (only for freight) with a EURO emission standard greater than a specified threshold. Special exemptions may be granted: resident's vehicles, private car park owners, public utilities, hotel guests, vehicles owned by shops or companies inside the LTZ, delivery goods, car sharing, home care, visiting doctors, night-time surveillance, artisans, funeral company, voluntary organizations.

RELATED MEASURES

The municipality applied the 'superblock model' in a suburban part of the city alongside the existing tramway line no.1. To reach a concrete reduction of car traffic, of transit traffic, Padova implemented infrastructural and/or traffic regulation measures like school streets and removing on-street parking spaces. This new traffic organization concept increased space and safety for pedestrians and cyclists in the superblock and in particular around the school district. The building block approach has been present in Padova for 15 years thanks to its engagement in environmentally friendly mobility measures. Public space interventions, like creating school streets or using former on-street parking spaces for other uses, are useful to demonstrate the contributions of UVARS.

IMPACTS, BENEFITS, NEGLECTED COSTS

The impacts of the Low Emission Zone (LEZ) on vehicle pollutant emissions were quantified, considering changes in travel habits induced by the drafted regulation (i.e., vehicle replacement, modal shift and destination change). A threefold evaluation framework was developed, composed of a behavioral model, a traffic simulation model and an emission model. Data from a mobility survey administered to future stakeholders, traffic counts, and characteristics of vehicles were used to calibrate the implemented models. The results of the model forecasting future behavior of travelers accessing the LEZ highlighted that a strong opposition could come from car drivers, suggesting that specific attention should be paid in targeting these stakeholders, for instance, by gradually applying access restrictions. In addition, a general unwillingness to adopt more sustainable travel behavior was highlighted. People are more willing to either maintain their vehicle, parking it outside the LEZ to avoid entering the area, or to replace it with a less polluting one, rather than shifting to a sustainable travel mode. This indicates that an increase in traffic flows and parking demand outside the LEZ could generate a spillover effect and the access of renewed vehicles could prevent a congestion and land use reduction within the LEZ. The analysis of the future modal share of individuals entering the regulated area pointed out that the measure could contribute to reduce the use of motorized private modes up to 8 %. A significant decrease in pollutant emissions was observed within the LEZ, generated by fleet renewal, modal shift, and destination changes, highlighting the effectiveness of the measure. Limited variations were obtained outside the area (around 1 %), and some scenarios exhibited a slight increase in pollutant emissions due to a spillover effect produced by long detours to avoid entering the zone.

SUCCESS or FAILURE FACTORS

Lessons learnt: 1) Be open to new ways of planning and experimenting with new measures, even those that seem not feasible for the local conditions at the first glance. 2) Don't expect one-size fits all solutions when implementing UVARs. Assess the wide field of possible activities and adapt the fitting ones to your local context. 3) Dedicate staff to study the feasibility of the measures before their implementation. 4) Connect with other cities and experts to learn how to overcome your capacity and knowledge gaps, such as evaluation elements and methodologies. 5) Invest in the communication of the new UVAR measures to stakeholders, residents and the general public. Take your time in creating a clear communication strategy and give people time to develop their understanding of the measures. 6) Avoid conservative and static planning approaches.

Percentage reductions of pollutant emissions generated by vehicles circulating within and outside the LEZ for the future scenarios.

Pollutant	Within the LEZ			Outside the LEZ		
	Average scenario	Minimum scenario	Maximum scenario	Average scenario	Minimum scenario	Maximum scenario
CO	−95.3 %	−90.6 %	−98.1 %	0.2 %	1.2 %	−1.1 %
CO2	−88.5 %	−76.6 %	−95.4 %	−0.5 %	0.0 %	−1.0 %
NOx	−98.8 %	−97.5 %	−99.5 %	−0.5 %	0.1 %	−1.4 %

OUTLOOK & TRANSFERABILITY

Potential for replication: 1) Do a detailed feasibility study before planning in detail. The study needs to investigate technical elements, economic scopes and impacts as well as the potential effects of UVAR measures in your specific context. 2) Position the UVAR measures in your main urban strategies and make them an integral element of your SUMP. 3) Exploit accepted strategic approaches like an environmental development policy to advocate the UVAR measures. 4) Use a push-and-pull approach complementing the supply of sustainable mobility means with UVAR measures to strengthen the effect of a modal shift.

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Publications: Low emission zone and mobility behavior: Ex-ante evaluation of vehicle pollutant emissions : https://doi.org/10.1016/j.tra.2024.104101

European Union-funded project "Regulating Vehicle Access for Improved Liveability" (ReVeAL), which has received funding from the European Union's Horizon 2020 research and innovation program under Grant https://civitas-reveal.eu/

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PIARC

GOOD PRACTICE FACT SHEETS

LEZ - ZEZ - ULEZ

5.5. Johannesburg Vehicle Emission (SOUTH AFRICA)

Keywords: **Vehicle emission reduction, strategic priorities, action plan**

DESCRIPITON IN SHORT

After development of its Air Quality Management Plan (AQMP) 2003 and 2019 the City of Johannesburg (CoJ) developed the Vehicle Emissions Control Strategy (VECS) and Action Plan (April 2021) which constitutes short-, medium- and long-term actions that aim to control and mitigate the contribution of vehicles on poor air quality. The following potential emission reduction interventions, in order of expected effectiveness, were considered:

1. Compliance with stricter emission reduction standards
2. Optimal low emission zones
3. High occupancy vehicle lanes
4. Congestion charges
5. Reduction in high emitters
6. Decreased daily mileage

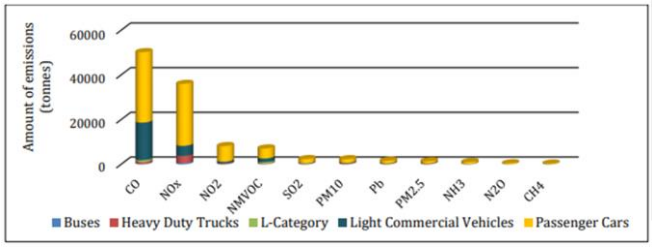
BACKGROUND

South Africa has made commitments under the Paris Agreement to reduce Green House gas emissions to between 398 and 618 MT CO_2e by 2030. The transport sector remains a significant contributor to South African emission statistics. As of 05 June 2019, the South African government announced the implementation of carbon tax of 9 cents per liter and 10 cents per liter on petrol and diesel, respectively, as a step towards achieving these emission targets (Kumalo, 2019).

The development of the COJ Vehicle Emissions Control Strategy (VECS) and Action Plan is mostly motivated by the Air Quality Management Plan (AQMP). The transport sector has been identified as one of the key sectors to target in improving air quality in the CoJ. In support, the 2019 AQMP identified four critical sources of air pollution that contribute negatively to air quality within the CoJ, one of which is vehicle emissions. Vehicle emissions play a significant role in reducing air quality by emitting Green House Gases such as Carbon Dioxide (CO_2) and other vehicle pollutants such as particulate matter, Nitrogen Oxide (NOx) and Carbon Monoxide (CO) which have adverse impacts on human and environmental health.

ELEMENTS

Passenger vehicles are the main contributors to total vehicle emissions in the CoJ, because the vehicle fleet here is dominated by passenger vehicles which account for about 60% of the total vehicle fleet.



Any intervention that would reduce the number of passenger vehicles in the CoJ will contribute highly to a reduction in the quantity of emissions and consequently improve the air quality.

Emissions by vehicle category

The aim of the VECS is to apply a holistic approach to reducing vehicle emissions by effectively executing the transition from a car-dominant city to one that values low carbon mobility and transport. This strategy aims to implement interventions that reduce the reliance on vehicles by investing in public transport and alternative mobility options, shifting travel patterns and encourage positive changes in travel behavior and vehicle usage.

RELATED MEASURES

The VECS Action Plan is a flexible document that assists the CoJ to facilitate the reduction of vehicle emissions to improve air quality. The successful implementation hereof requires a collaborative approach with internal and external stakeholders. This plan provides a basis for the CoJ to coordinate actions between departments, spheres of government and key stakeholders.

The Action Plan:

- Prioritizes key focus areas for vehicles, traffic and regulations, and relates it to key policies/legislation.
- Defines roles and responsibilities of internal and external stakeholders
- Identifies existing and other strategies that directly relate and align to these interventions.
- Considers social, economic and environmental impacts, and consequential mitigation measures.

IMPACTS, BENEFITS, NEGLECTED COSTS

The Vehicle Emissions Control Strategy (VECS) and Action Plan identified the following strategic priorities for reducing vehicle emissions in the city:

1. Improve vehicle performance efficiency through strategies and regulations that aim to improve vehicle characteristics (Phase out older, ill-maintained vehicles with outdated technology)
2. Increase the availability of low emission, integrated transport and mobility systems (encourage the transition from private vehicle to public transport).
3. Establish smart data- and monitoring systems to track air quality, vehicles characteristics, and traffic volumes and flow.
4. Formulate and implement awareness raising campaigns that link vehicle emissions to environmental and human health, and climate change.

SUCCESS or FAILURE FACTORS

Implementation of the Vehicle Emissions Control Strategy (VECS) and Action Plan depends on the following enabling factors:

1. Finance: sufficient and adequate funding is critical to the role out and success of this strategy.
2. Information flows – improving the air quality management system to understand the state of air quality, to support and measure the impact of decisions and to prioritize challenges.
3. Communicating with CoJ citizens through effective education programs, awareness raising and communications campaigns on air quality in the city.
4. Cross-sectoral collaboration to ensure the success of intervention implementation, reducing emissions and improving air quality in the city.
5. Innovation, research, and evidence-based decision-making.

Unfortunately, the implementation, status and success of the VECS and Action Plan could not yet be confirmed.

OUTLOOK & TRANSFERABILITY

The Vehicle Emissions Control Strategy (VECS) and Action Plan seems to be a sound and realistic approach to reduce vehicle emissions. It is however dependent on political will and buy-in with the consequential allocation of the required funding to implement the identified strategic priorities and to implement the necessary legislation/regulations.

Implementation will require a collaborative approached across the relevant departments in all spheres of government as well as all relevant stakeholders in the private sector to be involved in influencing the uptake and buy-in of the suggested interventions and driving the implementation thereof.

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GOOD PRACTICE FACT SHEETS

LEZ - ZEZ - ULEZ

5.6. Antwerp Low Emission Zone (BELGIUM)

Keywords: LEZ, air quality, traffic restrictions, ANPR, NO_2 Reduction, transport policy legislation, Antwerp, Belgium, public health, sustainable urban mobility

DESCRIPITON IN SHORT

The Antwerp Low Emission Zone (LEZ) was introduced on February 1, 2017, to combat air pollution and improve public health by restricting access to the most polluting vehicles. Spanning an area of approximately 20 square kilometers, it includes the city centre and the Linkeroever district. The scheme is operational 24/7 and applies to all motorized vehicles, including passenger cars, buses, and trucks, with specific emission standards determining access. In 2020, the LEZ recorded approximately 1.5 million vehicles entering daily, with about 2% of vehicles being non-compliant.

The LEZ's primary objective is to reduce air pollution, particularly nitrogen dioxide (NO_2) and fine particulate matter (PM10 and PM2.5), which have severe health impacts. A key milestone was the tightening of vehicle entry standards in 2020, aligning with Euro 5 for diesel vehicles and Euro 3 for petrol vehicles. Further adjustments are planned in 2025 and 2031, progressively phasing out older vehicles and further reducing emissions.

Antwerp LEZ map

BACKGROUND

Antwerp has long struggled with poor air quality, ranking among the worst in Belgium due to a combination of heavy traffic and industrial emissions. In 2015, the European Environment Agency identified Antwerp as one of the most polluted cities in the European Union for nitrogen dioxide (NO_2) levels. Studies further underscored the urgency for action, linking air pollution to severe health impacts, including respiratory and cardiovascular diseases, as well as over **400 premature deaths annually** within the city attributed to poor air quality.

The introduction of the Low Emission Zone (LEZ) was a direct response to these alarming figures. Established under the **Flemish Decree of November 27, 2015**, and supported by a **Flemish Government decision on February 26, 2016**, the LEZ provided local authorities with the legislative framework needed to restrict vehicle emissions in urban areas. This legal backing empowered Antwerp to enforce regulations aimed at reducing the number of high-polluting vehicles entering the city.

Moreover, the LEZ aligns with **EU Directive 2008/50/EC**, which emphasizes the need for cleaner air across Europe. By adhering to these standards, Antwerp's LEZ not only addressed local environmental challenges but also contributed to broader European objectives for improving public health and reducing pollution. The LEZ represents a significant step forward in tackling one of the city's most pressing environmental issues.

ELEMENTS

The LEZ operates based on the European Emission Standards (Euro norms), setting strict thresholds for vehicle access. Diesel vehicles must meet at least Euro 5 standards (as of 2020), while petrol vehicles must meet Euro 3 standards. Vehicles not meeting these standards can still access the zone through a paid daily permit, which costs €35. Electric vehicles, hydrogen-powered vehicles, and plug-in hybrids are exempt and granted automatic access.

Enforcement is carried out using Automatic Number Plate Recognition (ANPR) cameras, strategically positioned at entry points. These cameras cross-reference license plates with a central database to verify compliance. Non-compliant vehicles are fined €150 for a first offense, increasing to €350 for subsequent violations within 12 months.

The scheme is administered by the city of Antwerp, which also provides an online registration platform for foreign vehicles, ensuring comprehensive coverage and enforcement. The website “slimnaarantwerpen.be” allows people to see if their vehicle can be admitted and to receive information on the LEZ.

RELATED MEASURES

The LEZ is complemented by the "Smart Ways to Antwerp" program, which promotes sustainable mobility solutions such as public transport, cycling, and carpooling. Between 2017 and 2020, Antwerp invested €75 million in cycling infrastructure, resulting in a 40% increase in cycling trips. Additionally, the city has expanded its park-and-ride facilities to encourage the use of public transport.

Other measures include subsidies for electric and low-emission vehicles, the promotion of shared mobility schemes, and public awareness campaigns to encourage behavioural change. Together, these initiatives aim to reduce reliance on private vehicles and support the transition to cleaner transportation modes. Moreover, other related measures are the expansion of **cycling infrastructure** (e.g., €75 million investment between 2017–2020) and **park-and-ride facilities** to encourage alternatives to car use. and **"Smart Ways to Antwerp" Program, which** was promoting sustainable transport options such as cycling, public transport, and carpooling.

IMPACTS, BENEFITS, NEGLECTED COSTS

Since its implementation in 2017, the Antwerp Low Emission Zone (LEZ) has significantly improved air quality and public health while yielding economic benefits. Between 2017 and 2021, nitrogen dioxide (NO_2) concentrations in the city centre decreased by **26%**, while particulate matter (PM10) levels dropped by **18%**. The share of cleaner vehicles, particularly Euro 5 and Euro 6, increased by **65%**, demonstrating a successful transition to lower-emission fleets.

A study published in December 2024 further highlighted the LEZ's positive effects. It showed that NO_2 levels within the zone declined by **20%** between 2017 and 2020, particulate matter (PM10 and PM2.5) reduced by **18%**, and black carbon (BC), a marker of diesel emissions, fell by **25%**. Compared to other Belgian cities, Antwerp's LEZ achieved a faster reduction in pollutant concentrations.

Traffic volumes entering the LEZ also decreased slightly, with a **5% to 7% reduction during peak hours**, suggesting a modest shift toward alternative transportation modes. This shift, combined with improved air quality, contributed to a **10% reduction in respiratory and cardiovascular hospital admissions** among residents. Furthermore, life expectancy for those living within the zone increased by an estimated **3 to 4 months over a decade**.

Economically, the LEZ has generated approximately **€10 million annually** through fines and daily permits for non-compliant vehicles. These revenues were reinvested into sustainable mobility projects, such as cycling infrastructure and public transport, reinforcing the LEZ's broader objectives.

Despite these successes, the LEZ has faced criticisms. Low-income households struggled to afford newer, compliant vehicles, raising concerns about social equity and creating mobility challenges for vulnerable groups. Additionally, businesses within the LEZ reported temporary declines in customer footfall during the initial phase of implementation. Another challenge was the **spillover effect**, where traffic and pollution increased in areas just outside the LEZ as non-compliant vehicles rerouted to avoid fines.

In summary, while the Antwerp LEZ has delivered measurable environmental, health, and economic benefits, addressing social equity and spillover effects remains essential to ensure long-term sustainability and inclusivity.

SUCCESS or FAILURE FACTORS

The Antwerp Low Emission Zone (LEZ) owes its success to robust legislation, effective technology, and public engagement. Key legislative support from the Flemish Decree (2015) and alignment with EU Directives ensured consistency and credibility. Technology, such as **Automatic Number Plate Recognition (ANPR) cameras**, enabled accurate enforcement, while continuous monitoring allowed evidence-based refinements, like tightening standards in 2020. Integration with broader mobility strategies, including reinvestment of €10 million annually from fines into sustainable transport projects, further supported its goals. Public engagement, through multilingual outreach and workshops, fostered acceptance and compliance.

However, challenges included **social disparities**, as low-income groups faced barriers to upgrading vehicles, and **spillover effects**, where traffic and pollution increased outside the LEZ boundaries. These issues highlighted the need for expanded financial incentives and regional coordination.

Key lessons include providing subsidies, maintaining robust monitoring, and prioritizing public engagement are critical to success. Despite its challenges, the Antwerp LEZ demonstrates how targeted UVAR policies can improve air quality and public health while integrating with sustainable urban strategies.

OUTLOOK & TRANSFERABILITY

Antwerp plans to tighten LEZ standards further, with Euro 6 becoming mandatory for diesel vehicles by 2025 and stricter regulations extending to 2031. The city also aims to integrate real-time air quality monitoring and expand the scheme's geographical coverage.

The LEZ model is transferable to other urban areas, particularly those with high traffic volumes and poor air quality. However, successful implementation requires a supportive legislative framework, comprehensive public communication, and sufficient alternative mobility options. Cities considering similar schemes should also address potential social inequities and provide financial assistance to affected populations.

MORE INFORMATION
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Publications:

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GOOD PRACTICE FACT SHEETS

LEZ - ZEZ - ULEZ

5.7. MADRID LOW EMISSION ZONE (SPAIN)

Keywords: Low Emission Zone, vehicle restriction, air pollution, congestion.

DESCRIPITON IN

Madrid implemented a LEZ with the goal of improving air quality and promoting a city center more friendly for pedestrians, cyclists, neighbors, and visitors. The LEZ restricts the entry of vehicles that do not meet certain emissions standards. Madrid currently has two LEZs:

- "Madrid Central": covering the city center, it started operating in November 2018 and was expanded in 2021, when its name was changed to "Madrid 360".
- "Plaza Elíptica": less restrictive than "Madrid Central". Located around Plaza Elíptica, it began operating in December 2021.

BACKGROUND

The growth in the number of trips in the Madrid region, especially by private vehicle, increased emissions of pollutants (e.g., NOx and PM) and greenhouse gases. Road traffic is responsible for 74.4% of local emissions in Madrid city. This situation causes, since 2011, repeated episodes of high pollution where the maximum thresholds established by the European Union for NO_X and O_3 are exceeded.

To improve air quality and help prevent climate change, in 2017 Madrid City Council developed a comprehensive plan called Plan A. Because of its impact on the population and the debate it generated, Plan A's flagship policy was the implementation of a LEZ called "Madrid Central". The objective of "Madrid Central" was to develop sustainable mobility by reducing the use of private vehicles and promoting public transport and non-motorized transport, thus creating a more livable city center.

To reduce the use of private vehicles, "Madrid Central" imposed restrictions on private cars and motorcycles according to five environmental labels that are standardized at national level and based on the Euro Emissions Standards. It should be noted that motorcycles are generally less restricted than cars. In addition, general exceptions apply to disabled persons, residents, security and emergency services, and freight distribution. Moreover, residents have 20 invitations per month to allow their guests access "Madrid Central".

The actual Environmental Sustainability Strategy called "Madrid 360" included "Madrid Central" and "Plaza Elíptica" and its implementation took place in 2021. Since 2006, Madrid had adopted restrictions for episodes of high pollution. Based on these experiences, the city developed its Sustainable Mobility Ordinance in 2018, a comprehensive legal framework that laid the foundations for the implementation of the current LEZs.

ELEMENTS

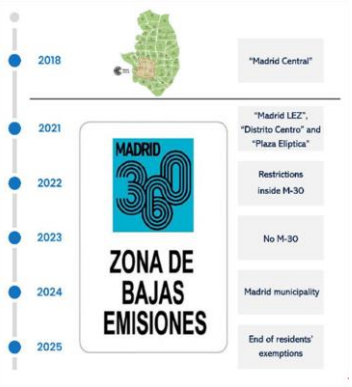
Access to "Madrid Central" is subject to residential location, vehicle typology and environmental label.

Population		Environmental label				
		A	B	C	Eco	Zero
Not residents	Car	No	Except to parking/garages	Except to parking/garages	Yes	Yes
	Motorcycle	No	Restricted hours (7 to 22h)	Restricted hours (7 to 22h)	Yes	Yes
	Freight distribution	No	Restricted hours	Restricted hours	Yes	Yes
Guests (max.20/ month)		Yes (until 2020)	Yes	Yes	Yes	Yes
Residents		Yes (until 2025)	Yes	Yes	Yes	Yes

Source: Plan A (2017)

To monitor compliance with the restrictions, the Madrid City Council has installed over 200 cameras at various points throughout the capital. Drivers who violate the LEZ restrictions may be fined 200 euros.

"Plaza Elíptica" prohibits vehicles with environmental label A from accessing and circulating inside its perimeter. It applies similar exceptions to "Madrid Central".



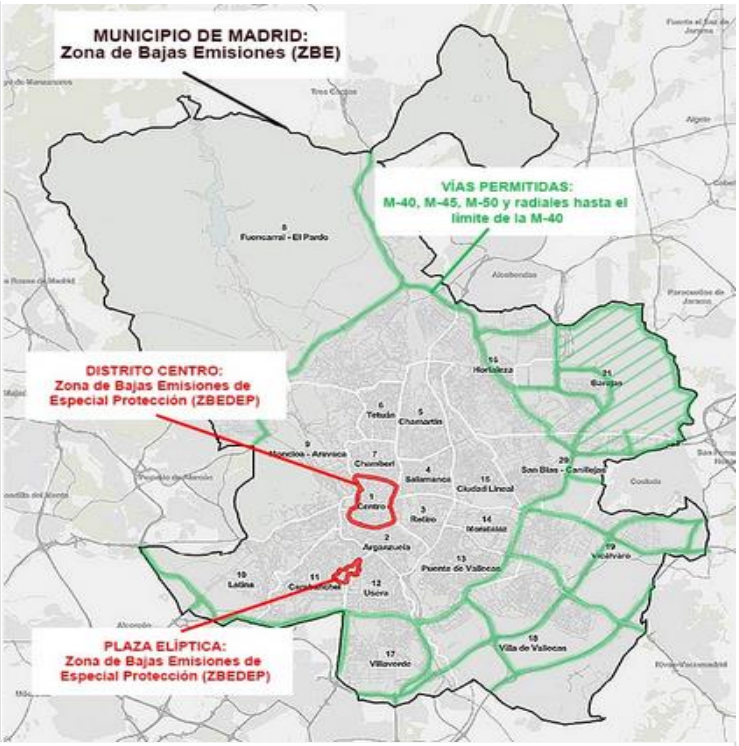
"Madrid 360" includes both "Madrid Central" and "Plaza Elíptica". "Plaza Elíptica" is less restrictive than "Madrid Central".

RELATED MEASURES

With the implementation of Madrid's LEZ, various compensatory measures were implemented. One of the main approaches is the renewal of the vehicle fleet through the "Cambia 360 Plan", which offers grants for the purchase of less polluting vehicles. Discounts on public transportation were introduced for young people and seniors, and public transportation infrastructure was improved. Additionally, electric vehicle charging points were installed throughout the city.

Incentives and aids were launched to encourage the use of alternative forms of transport such as bicycles, public transportation, and to promote digitalization and online commerce.

On the other hand, the City Council has provided consultancy and training for businesses facing challenges arising from the LEZ.



IMPACTS, BENEFITS, NEGLECTED COSTS

Effects of the implementation of LEZ in Madrid ("Madrid Central" and later "Madrid 360"):

- 19% reduction in pollution.
- 16% reduction in congestion.
- Consumers affected by the measures reduced their spending by 21% in physical stores within the LEZ.
- Reduction in pollution in the rest of the city.
- Slight reduction in noise levels.
- The modal split remained similar to that before the implementation of the LEZ.

SUCCESS or FAILURE FACTORS

Critical factors in the implementation of Madrid's LEZ:

- Initial resistance from the population, as well as from drivers and merchants, due to the potential impact on their activities.
- Lack of clarity in regulations, with frequent changes and insufficient information.
- The high cost of technology infrastructure and LEZ management.
- The lack of integration between mobility systems complicated implementation and limited the LEZ's effectiveness in its early stages.

The LEZ's success factors include all those related to positive impacts such as the reduction in pollution, congestion, and noise.

OUTLOOK & TRANSFERABILITY

Madrid's LEZ has prospects for expansion to include new urban and peri-urban areas, with plans to adjust regulations and facilitate access to less polluting vehicles. The integration of new technologies is also anticipated to improve traffic monitoring and management.

The potential for transferring the LEZ model to other urban areas is significant, particularly in similar cities. However, the success of implementing a similar scheme depends on public acceptance, collaboration among governments, businesses, and citizens, and the availability of suitable infrastructure.

To facilitate transferability to other areas, it is recommended to conduct feasibility studies that assess local conditions, establish a legal framework that addresses each area's specific needs, and encourage citizens participation in the design and execution of the scheme.

MORE INFORMATION

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GOOD PRACTICE FACT SHEETS

LEZ - ZEZ - ULEZ

5.8. BARCELONA LOW EMISSION ZONE (SPAIN)

Keywords: **Low Emission Zone, urban air quality, urban mobility, congestion.**

DESCRIPITON IN SHORT

In Barcelona, the LEZ was implemented in January 2020 in the area located inside the ring roads "Rondas de Barcelona". This area covers more than 95 km² and includes the entire municipality of Barcelona (except the Zona Franca Industrial area and the neighborhoods of Vallvidrera, Tibidabo, and Les Planes), as well as the municipalities of Sant Adrià de Besós and L'Hospitalet de Llobregat, and parts of the municipalities of Esplugues de Llobregat and Cornellà de Llobregat.

BACKGROUND

In 2018, 48% of Barcelona's citizens were exposed to nitrogen dioxide (NO_2) levels, and 95% to particulate matter (PM10) levels, exceeding recommended limits.

Moreover, in 2019, Barcelona had an average congestion rate of 29%, defined as the percentage difference between actual travel time and travel time under free-flowing traffic conditions, ranking it 8th among the most congested cities in Europe. Barcelona's geographic location in northern Spain, surrounded by mountains and bordered by the Mediterranean Sea to the east, combined with its high population density and traffic, makes it particularly vulnerable to pollution problems stemming from road traffic.

The implementation of the LEZ in Barcelona addresses the need to comply with various European and national regulations, including Law 34/2007 on air quality and atmospheric protection, which aims to prevent and reduce air pollution in Spain.

During the implementation process of Barcelona's LEZ, participatory spaces were established, such as the workshop about air pollution, which brought together all the stakeholders involved. Additionally, a participatory forum called "The Pact for Mobility" was organized to encourage dialogue and debate. Lastly, a participation process was launched through the Decided Barcelona platform to gather citizens' opinions and foster a discussion on the specifics of the ordinance.

ELEMENTS

The restriction measures were progressively applied in the following stages:

- 2019: Restricted circulation during pollution episodes for cars and other light vehicles without an environmental label.
- 2020: Permanent ban on circulation within the LEZ for cars, motorcycles, and mopeds without a DGT environmental label from 7:00 a.m. to 8:00 p.m., Monday to Friday.
- April 2021: Expansion of the permanent ban within the LEZ to include vans without environmental label from 7:00 a.m. to 8:00 p.m., Monday to Friday.
- 2022: Expansion of the permanent ban within the LEZ to include trucks and small buses without environmental label from 7:00 a.m. to 8:00 p.m., Monday to Friday.
- July 2022: Expansion of the permanent ban within the LEZ to include buses used for collective passenger transport without environmental label from 7:00 a.m. to 8:00 p.m., Monday to Friday.

These measures allow for exceptions with prior registration, including people with reduced mobility, special or unique service vehicles, daily permits (10 per year), regular medical treatments, etc.

The LEZ has an automatic monitoring system with over 100 license plate-reading cameras to identify non-compliant vehicles which are subjected to penalties. Additionally, the Local Police may conduct inspections.

RELATED MEASURES

Within the framework of Barcelona's LEZ, compensatory measures were implemented to facilitate more sustainable mobility and mitigate the impact on the groups most affected by restrictions on polluting vehicles. These measures include financial aid for the renewal of the vehicle fleet, the promotion of public transportation through the T-Verde card, which offers three years of free travel to those who deregister a vehicle without replacing it (14,000 T-Verde cards were granted), moratoriums and exceptions for vulnerable groups or professionals dependent on vehicles, and the promotion of electric mobility with incentives for purchasing electric vehicles and installing charging points.

To mitigate the economic impact on certain sectors, temporary authorizations were granted for professional vehicles, and financial assistance was provided to support the transition to less polluting alternatives. Furthermore, annual authorizations were offered to owners of polluting vehicles with low incomes.

IMPACTS, BENEFITS, NEGLECTED COSTS

- Reduction in levels of NO_2, PM_{10}, and $PM_{2.5}$.
- Decrease in traffic in restricted areas, creating a safer and more accessible environment for pedestrians and cyclists.
- The LEZ has promoted the use of public transportation as well as other sustainable modes of transport.
- Opposition from small businesses and shops.

SUCCESS or FAILURE FACTORS

Success Factors: The LEZ has benefited from strong political support, aligning with sustainability and public health policies. Compensatory measures have facilitated the transition to less polluting vehicles. Additionally, the LEZ has raised public awareness about air quality and the need to reduce pollution, supported by positive results in the decrease of NO_2 and PM_{10} levels in the city. Finally, the collaboration and participation of various social stakeholders, including non-governmental organizations and citizens, have allowed for the integration of diverse perspectives in the implementation of the LEZ.

Failure Factors: There is still resistance from the citizens, and overall, from certain sectors, such as merchants and drivers. Moreover, social inequalities have become evident, as the restrictions impact citizens with fewer resources more significantly. A problem of misinformation among the public regarding LEZ regulations was also identified, leading to unintentional violations. Furthermore, public transportation has faced challenges in accommodating the increased demand, and the need for ongoing evaluations and adaptations was highlighted as crucial for the long-term success of the LEZ.

OUTLOOK & TRANSFERABILITY

The implementation of the LEZ in Barcelona provides a valuable case study for other cities looking to reduce air pollution and improve urban mobility. As urban areas worldwide face similar challenges related to congestion and environmental degradation, the lessons learned from Barcelona's experience (such as the importance of strong political support, effective public engagement, and the establishment of compensatory measures) can be adapted and replicated.

Moreover, the success in improving air quality and raising public awareness demonstrates the potential for positive outcomes when a city commits to sustainability initiatives.

Barcelona’s LEZ offers valuable lessons for other cities, though its transferability depends on unique local factors. Its participatory governance fosters public engagement, a challenge in less transparent contexts. Geographically, mountains and the Mediterranean worsen pollution, adding urgency to action. The transition benefited from robust public transport and active mobility infrastructure, often lacking elsewhere. High population density also makes sustainable alternatives more feasible than in sprawling cities. Finally, programs offering free public transport for retiring polluting vehicles depend on financial resources not always available in other urban contexts.

MORE INFORMATION

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GOOD PRACTICE FACT SHEETS

LEZ - ZEZ - ULEZ

5.9. LONDON ULTRA LOW EMISSION ZONE (UK)

Keywords: LEZ, ULEZ, Congestion Charging, air pollution, London

DESCRIPTON IN SHORT

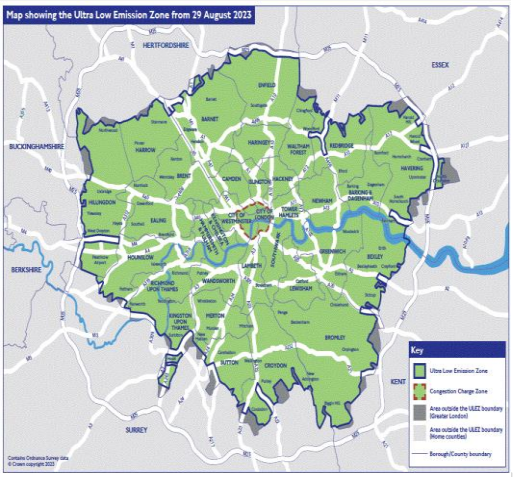
London's Low Emission Zone (LEZ), introduced in 2008, and Ultra Low Emission Zone (ULEZ), launched in 2019, aim to combat air pollution by enforcing stringent emissions standards for vehicles. The LEZ targets heavy vehicles across Greater London, while the ULEZ applies stricter rules to all vehicles entering Central London, with a recent expansion to cover most of the city.

The ULEZ boundary is now the same as the boundary for the Low Emission Zone (LEZ) for heavy vehicles.

The London-wide zone measures 1,500 km2 and covers nine million people, making it the largest zone of its kind in the world.

The main objectives of the London ULEZ comprise:

- Air quality improvement
- Protect public health
- Encourage cleaner vehicles
- Support sustainable transport



BACKGROUND

According to World Health Organization guidance, every outer London borough exceeds the safe limit for NO_2 and particulate matter. The 5 boroughs with the highest rate of emergency adult asthma hospital admissions in 2018-19 were all in outer London. More than 500,000 people in London have asthma, with over half of these people living in outer London. Furthermore, the greatest number of premature deaths attributable to air pollution are in outer London boroughs, due to the higher proportion of elderly Londoners in these boroughs who are more vulnerable to the negative health impacts.

Whilst the ULEZ was not directly mandated by EU air quality directives, it was implemented to help London meet air quality standards, which are influenced by both EU directives and UK national laws.

London's journey toward reducing vehicular emissions began with the introduction of the **Low Emission Zone (LEZ)** in **February 2008**. This initiative targeted heavy diesel vehicles, such as buses and lorries, enforcing minimum emission standards and imposing charges on non-compliant vehicles. The LEZ covered most of Greater London and aimed to improve air quality by discouraging the use of the most polluting vehicles.

Building upon the LEZ, the concept of an **Ultra Low Emission Zone (ULEZ)** was designed to enforce stricter emission standards on a broader range of vehicles, including cars, motorcycles, and smaller vans, operating within the designated area, this came into operation in **April 2019**, covering central London. This zone required vehicles to meet stringent emission standards or face a daily charge, aiming to reduce harmful pollutants and improve air quality in the city centre.

The ULEZ has been extended twice since implementation. First in **October 2021** to cover areas within the North and South Circular roads, increasing the zone's coverage to include more residential areas, affecting a larger number of vehicles and further promoting the use of cleaner transportation options.

Again, in **August 2023**, to encompass all 32 London boroughs, effectively covering the entire city. This move aimed to address air quality issues on a city-wide scale, ensuring that more residents benefit from reduced pollution levels.

Throughout its evolution, London's emission control policies have progressively tightened, reflecting a commitment to improving air quality and public health.

ELEMENTS

Most vehicles need to meet the ULEZ emissions standards or pay a daily charge to drive within the zone. This includes cars, motorcycles, vans and specialist vehicles (up to and including 3.5 tonnes) and minibuses (up to and including 5 tonnes). Lorries, vans or specialist heavy vehicles (all over 3.5 tonnes) and buses, minibuses or coaches (all over 5 tonnes) do not need to pay the ULEZ charge. They will need to pay a LEZ charge if they do not meet the LEZ emissions standards.

There are a range of charging times, depending upon the zone you are travelling within:

- **Congestion Charge (CC):** Operates 07:00-18:00 Mon-Fri, 12:00-18:00 Sat-Sun and most bank holidays.
- **ULEZ:** Operates 24 hours a day, midnight to midnight, every day of the year expect Christmas Day.
- **LEZ:** Operates 24 hours a day, midnight to midnight, every day of the year.
- **Direct Vision Standard (DVS) and HGV Safety Permit:** at all times for lorries over 12 tonnes gross vehicle weight.

The ULEZ uses Automatic Number Plate Recognition (ANPR) for enforcement, supported by signage including: advanced information signage on major roads, directional signage, boundary signs at every entry point to the ULEZ, and reminder sings within the ULEZ.

- Compliance rates have increased for both cars and vans; 97.1 per cent of cars and 88.9 per cent of vans.
- There are fewer older, more polluting ULEZ vehicles seen driving in the zone. On an average day, there were 90,000 fewer non-compliant vehicles detected in February 2024 compared to June 2023. This is a 53% reduction in non-compliant vehicles between those dates.
- Areas outside London are also seeing the impacts of the ULEZ, with roadside NO2 concentrations within 5 km of the Greater London boundary on average nine per cent lower in 2023 than an estimated "No ULEZ" scenario.
- Harmful roadside NO2 concentrations are estimated to be:
- 21 per cent lower in outer London than they would have been without the ULEZ and its expansions.
- 53 per cent lower in central London than they would have been without the ULEZ and its expansions.
- 24 per cent lower in inner London than they would have been without the ULEZ and its expansions

RELATED MEASURES

Complementary Measures:

- **London Congestion Charge**, compliments the ULEZ through reducing traffic volume, encouraging cleaner vehicles, air quality improvements over a larger area and financial incentives.
- Investment in active mobility and public transport, more money spent on expanding bus services, cycling infrastructure, pedestrian-friendly projects, Electric Vehicle Infrastructure,
- **Low Emission Bus Zones** use buses with top-of-the-range engines and exhaust systems that meet or exceed the highest Euro VI emissions standards. The zones have been prioritised in the worst air quality hotspots outside central London where buses contribute significantly to road transport emissions.
- **ULEZ scrappage Scheme** which closed in Sept 2024, had 54,000 successful applications. This provided grant payments to successful applicants to scrap or retrofit vehicles that do not meet the emissions standards and switch to cleaner, greener modes of transport.

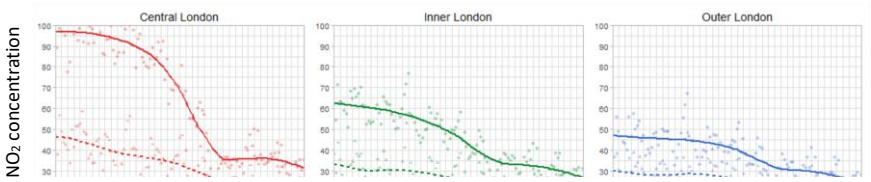
IMPACTS, BENEFITS, NEGLECTED COSTS

Measurable Improvements:

1. **Reduction in Emissions**: The expansion of the ULEZ has led to a notable decrease in harmful emissions. There has been a 44% reduction in roadside NO_2 levels since the ULEZ was introduced. NOx emissions from cars and vans in outer London are estimated to be 13% and 7% lower, respectively, compared to a scenario without the ULEZ. PM2.5 exhaust emissions from cars and vans in outer London are estimated to be 20% lower.
2. **Improved Air Quality**: Roadside NO_2 concentrations in outer London were up to 4.4% lower in the first six months of the London-wide ULEZ operation. This improvement in air quality benefits the health of residents, particularly those with respiratory conditions.
3. **Fewer Polluting Vehicles**: The number of older, more polluting vehicles has significantly decreased. Each day, 74,000 fewer polluting vehicles are seen driving in the zone, a reduction of 60% since the expansion in October 2021.

Adverse Effects:

1. **Financial Impact on Drivers**: Some residents and businesses have faced financial challenges due to the need to upgrade vehicles to meet ULEZ standards. This has been a particular concern for those who rely on older vehicles for their livelihood.
2. **Displacement of Traffic**: There have been reports of increased traffic in areas just outside the ULEZ boundary as drivers seek to avoid the charges. This can lead to localized congestion and pollution in these areas.
3. **Compliance Costs**: The cost of compliance, including vehicle upgrades and potential fines for non-compliance, has been a burden for some individuals and small businesses.



SUCCESS or FAILURE FACTORS

The effectiveness of the ULEZ can be attributed to several key success factors:

1. **Extensive Public Engagement and Consultation**: before the implementation and expansion of the ULEZ.
2. **Comprehensive Awareness Campaigns**: launched to inform residents and businesses about the ULEZ.
3. **Innovative Technologies**: the use of ANPR cameras for enforcement.
4. **Financial Incentives**: Scrappage schemes and grants introduced to help residents and businesses, making it easier to comply.
5. **Investment in Public Transport and Active Mobility**: Significant investments were made providing viable alternatives to driving.
6. **Health and Environmental Benefits**: clear communication of the health and environmental benefits of the ULEZ.
7. **Political Leadership**: strong political leadership and commitment from the Mayor of London and city officials were essential in driving the implementation and expansion of the ULE.

Some areas of concern and criticism:

1. **Financial Burden on Residents and Businesses**: cost of upgrading vehicles to meet ULEZ standards has been a significant financial burden for some residents and small businesses.
2. **Displacement of Traffic**: reports of increased traffic in areas just outside the ULEZ boundary as drivers seek to avoid the charges. This can lead to localized congestion and pollution in these peri-urban areas.
3. **Compliance Costs**: vehicle upgrades and potential fines for non-compliance, has been a burden for some.
4. **Legal Challenges**: The expansion of the ULEZ has faced legal challenges from some local councils, which argued that the expansion was not justified. Although these challenges were ultimately unsuccessful, they highlighted the contentious nature of the policy.
5. **Public Opposition**: the ULEZ has faced opposition from some groups arguing it affects lower-income individuals and small businesses.

OUTLOOK & TRANSFERABILITY

The ULEZ is subject to regular reviews and adjustments based on its effectiveness and the latest air quality data. This ensures that the zone continues to meet its objectives of reducing emissions and improving air quality. As of now, there are no specific plans announced for further expansions of the ULEZ beyond its current coverage, which includes all London boroughs up to the M25 motorway.

There may be future changes to the emission standards required for vehicles to comply with the ULEZ, making them stricter to further reduce pollution. There will also be continued investments in public transport and active mobility infrastructure are planned to support the ULEZ. This includes increasing the number of zero-emission buses and expanding cycling and pedestrian facilities.

Whilst the ULEZ model could be adapted to peri-urban areas, it must be tailored to the specific needs and conditions of each location to be effective. With consideration given to local air quality needs, public and political support, infrastructure and technology, financial incentives and regulatory framework required for supporting the implementation and enforcement.

MORE INFORMATION

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Publications:

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GOOD PRACTICE FACT SHEETS

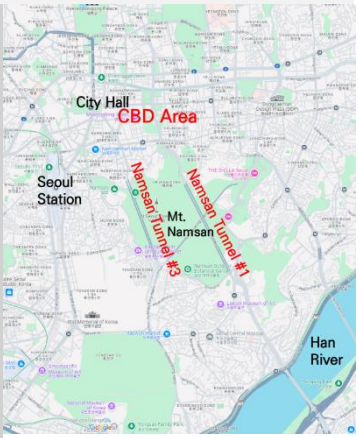
CS

5.10. SEOUL CONGESTION CHARGING (SOUTH COREA)

Keywords: Congestion Charging, Traffic Management, Pricing Model, Seoul Metropolitan Government, Alternative Routes, Public Transportation

DESCRIPITON IN SHORT

Seoul's notorious traffic congestion led to the implementation of a congestion pricing scheme in 1996. The scheme involved charging a toll for private vehicles passing through specific tunnels during weekdays. The primary goal of the congestion pricing was to reduce demand for private vehicles. This was achieved by encouraging drivers to use public transportation or carpool. However, there were criticisms about the effectiveness of daytime tolls and the lack of inflation adjustment. To address these concerns, the city temporarily exempted toll fees for both southbound (leaving from CBD) and northbound (entering to CBD) traffic. The results of the experiment showed that while exempting tolls for southbound traffic had limited impact, exempting tolls for both directions led to a significant increase in traffic and a decrease in traffic speed. Based on these findings, the city decided to maintain the toll fee for northbound traffic only. One of the key benefits of the congestion pricing scheme was a shift towards public transportation. Fewer cars with one or two occupants used the tunnels, and the number of buses and taxis increased significantly.



BACKGROUND

Seoul has earned a notorious reputation for its severe traffic congestion. In order to mitigate the congestion problem, the transportation policy of Seoul Metropolitan Government (SMG) had been mainly focused on the supply of transportation systems until the early 1990's. However, after 1993, the SMG has approached traffic problems from a different angle in response to the limitation of the past transportation policy to solve the traffic congestion problem.

The new approach is to manage the demand of transportation systems by implementing a congestion pricing scheme. The SMG started charging, from November 11 in 1996, 2,000 KRW (about USD 1.5) congestion toll for one and two persons (including driver) occupied private vehicles passing through the Namsan #1 and #3 tunnels. The two tunnel corridors link the southern part of the Han River and the old downtown area. The two tunnel corridors were notorious for excessive private vehicle use.

The SMG stopped collecting toll fees for the first time in 27 years from March 17 to May 16 of 2023 as a temporary pricing model to decide whether to scrap the toll collection system. For the first month, toll fees were exempted for southbound traffic only, while for the second month toll fees were exempted for both directions.

ELEMENTS

The toll charges are collected for vehicles travelling in both directions per entry from 7 a.m. to 9 p.m. during weekdays. Saturdays, Sundays and national holidays are free of charge. The violation penalty amounts to 10,000 KRW (five times the congestion fee). The following vehicles are exempted from the charge: three or more persons occupying private vehicles, all buses, vans, trucks, diplomats' vehicles, reporters' vehicles, government vehicles, and ceremony vehicles. 50% discount of toll is applied to light-weight passenger cars (less than 1000 cc) and low-emission vehicles (Class 1 and 2). Cash, transportation card and credit card are accepted at the tollbooth, and automatic payment is also available if vehicle license number and payment information is pre-registered.

Figure 9. Toll plaza of Namsan #1 and #3 tunnel

RELATED MEASURES

According to the Urban Traffic Readjustment Promotion Act (ensure smooth traffic and promote convenience in traffic in urban areas by promoting the improvement of traffic facilities and efficiently operating and managing means of transport and traffic systems), a congestion charge must be levied on road segments according to the travel speed and average delay. The main targets are arterial roads or adjacent zones that affect such roads where the average travel speed is less than 21 km/h (for four lanes or more, one way) or 15 km/h (for three lanes or less, one way) on weekdays only for three or more time periods per day. By this standard, most major roads in Seoul at the time when the introduction of the charge was being discussed were subject to the congestion charge. Knowing that the sudden introduction of the charge in most or all of Seoul would likely meet severe opposition, the city aimed to phase in the system.

IMPACTS, BENEFITS, NEGLECTED COSTS

From 1996 to 2021, tunnel traffic dropped around 20 percent, from about 90,400 cars daily to 71,900. The average speed of vehicles passing through the tunnels also increased from 21.6 kilometers per hour (13.4 miles per hour) to 38.2 kilometers per hour in the same period. However, criticism of the effectiveness of daytime tolls and the toll's failure to reflect inflation prompted the SMG to examine the impact of such fees in 2021.

When toll fees were exempted just for southbound traffic, the traffic rate increased to around 5.2 percent but had no significant congestion overall except for a 5 to 8 percent speed reduction on roads directly connected to the tunnel. On the other hand, when toll fees were exempted for both directions, traffic increased by 12.9 percent, and the traffic speed on major city streets decreased significantly, by 13 percent.

After conducting the two-month policy experiment and consulting with related experts, the SMG decided to maintain the 2,000 KRW toll fee on northbound traffic only, effective on Jan 15, 2024, as its effects were visible.

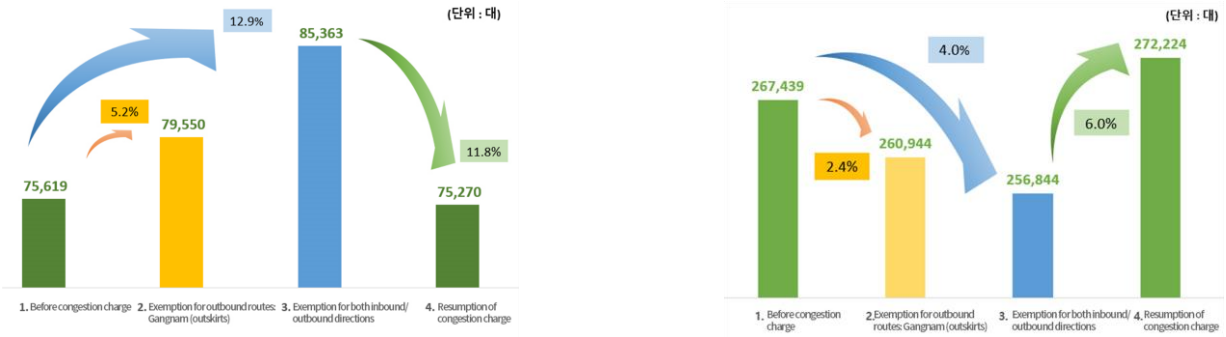


Figure 2. Traffic volume change during social experiment: Namsan Tunnel (Left) and Alternative routes (Right)

SUCCESS or FAILURE FACTORS

One of the most important outcomes of introducing the congestion impact charge was that cars with only one or two occupants stayed away from the tunnels, and the occupants began more frequently resorting to public transport such as buses or taxis. A study conducted by the Seoul Institute in 2012 indicated that the number of personal cars passing through Namsan Tunnels 1 and 3 dropped by 25.8%, while the number of buses increased by 4.7% in 2010, compared with 1996, the year in which the congestion impact fee system was originally implemented. Meanwhile, the share of buses and taxis during peak commuting hours soared from 3.3% and 7.8% to 8.0% and 26.4%, respectively.

Four roads near Namsan Tunnels 1 and 3 can be used as detours, inevitably raising concerns that the imposition of the congestion charge would simply cause congestion in other areas as cars moved to the detour roads. According to a year-long study after the introduction of the charge, traffic volume on the detour roads rose by only 5.7%.

OUTLOOK & TRANSFERABILITY

Congestion charging policy of SMG was made possible due to its geographical specificity, that is, a tunnel between urban areas and major access areas in the south, enabling link-based toll collection. Therefore, when adopting SMG's case in other regions, major toll collection points should be selected in consideration of geographical conditions, or area-wide toll collection policy should be established, such as London or Singapore. In addition, congestion charges should be determined at a level that can induce the abandonment of the choice of private car travel in consideration of the price index level and the rate of inflation.

MORE INFORMATION
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GOOD PRACTICE FACT SHEETS

CS

5.11. KAWASAKI ENVIRONMENTAL ROAD PRICING (JAPAN)

Keywords: Environmental Road Pricing, traffic volume, heavy vehicle, electronic toll collection (ETC), environmental improvement …

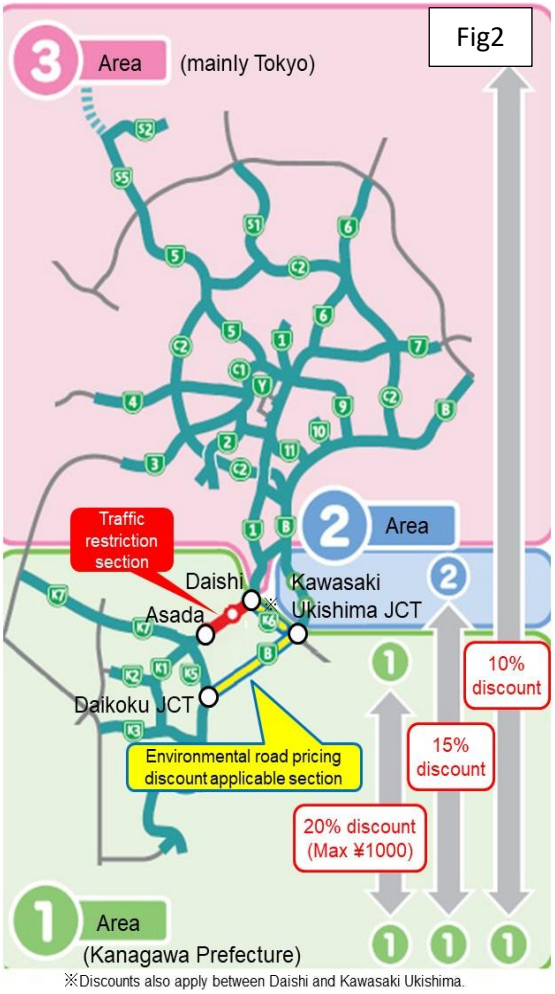
DESCRIPTON IN SHORT

In southern Kawasaki, located between Tokyo and Yokohama, air pollution caused by emissions from nearby factories, power plants and running vehicles had become a serious problem. In 2001, Environmental Road Pricing, which provides toll discounts on the Bay Shore Route, was launched to encourage heavy vehicles to switch from the Yokohane Route, located in residential areas, to the Bay Shore Route in bay-side industrial area. As a result, in terms of the share of the traffic, the share on the Yokohane Route decreased compared to the Bay Shore Route, and the share on ordinary roads also decreased, contributing to environmental improvement in the area.

BACKGROUND

In southern Kawasaki, located between Tokyo and Yokohama, air pollution caused by emissions from nearby factories, power plants in Keihin Industrial Zone, had become a serious problem, as well as gas emissions of running vehicles on roads, including local roads.

There are five routes connecting Tokyo and Yokohama: expressways (Yokohane and Bay Shore Routes, both tolled expressways) and ordinary roads (Industrial Road, National Highway Routes 1 and 15, all of them are non-tolled ordinary roads). Those are the arterial roads in the Capital Area. Metropolitan Expressway Company, which manages the Yokohane and Bay Shore Routes, considers the need to take measures to improve the environment along the expressways, and in 2001 it started Environmental Road Pricing to encourage heavy vehicles to shift driving from the Yokohane Route, located in residential areas, to the Bay Shore Route in the waterfront.



※Discounts also apply between Daishi and Kawasaki Ukishima.

ELEMENTS

Environmental Road Pricing applies to ETC-equipped heavy vehicles that drive on the Bay Shore Route between Kawasaki Ukishima JCT and Daikoku JCT, instead of the Yokohane Route between Daishi and Asada in Kawasaki City. These vehicles get a toll discount on the Bay Shore Route. There are three types of discount rates depending on the starting and ending points.

The discount rate is higher when the starting and ending points are within Kanagawa Prefecture. The toll is set at 1,000 yen to maximum. If the toll is less than 1,000 yen, a 20% discount will be applied (as of September 2024).

RELATED MEASURES

To improve the recognition of and promote the use of Environmental Road Pricing, various public relations (PR) activities have been conducted, including displaying banners, handing out pamphlets, utilizing VMSs, the website, and radio broadcasting, etc.

Displaying banners about Environmental Road Pricing

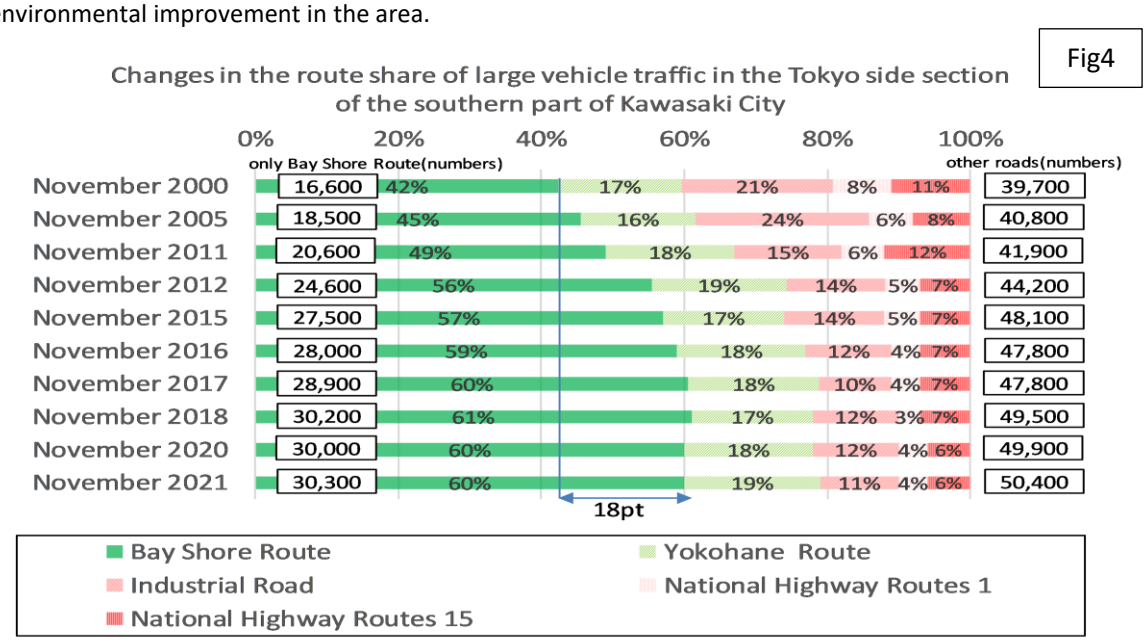
Fig3

IMPACTS, BENEFITS, NEGLECTED COSTS

When comparing the Bay Shore Route and other roads including Yokohane Routes, the share of the traffic in Bay Shore Route has increased by about 18 % around 2021 since the introduction of environmental road pricing in 2001. And it may be reasonable to conclude the said figure represents the effect of Environmental Road Pricing.

In addition, when comparing the expressway and ordinary roads, the share of the traffic volume of ordinary roads has decreased. It is assumed that environmental road pricing diverted heavy vehicles from the Yokohane Route to the Bay Shore and as a result, some of ordinary road traffic was then converted to the Yokohane Route, which has more traffic capacity. Since highways generally emit less exhaust gas from heavy vehicles than general roads, which repeatedly start and stop at intersections, environmental road pricing is thought to contribute to environmental improvement in the area.

Fig4



SUCCESS or FAILURE FACTORS

Factors that made this initiative successful include the fact that the toll discount allowed drivers to use expressways at lower cost and the PR efforts through a variety of media have raised the recognition of Environmental Road Pricing and promoted its use.

OUTLOOK & TRANSFERABILITY

We will continue to closely monitor the traffic conditions and actively work on improving roadside conditions in southern Kawasaki area, including PR activities of Environmental Road Pricing.

If there are multiple routes to a certain destination, we believe that Environmental Road Pricing could be applied, as in the case of southern Kawasaki.

MORE INFORMATION

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GOOD PRACTICE FACT SHEETS

5.12. MARIBOR LIMITED TRAFFIC MAIN SQUARE (SLOVENIA)

Keywords: UVAR, Urban Planning, Traffic Management, Mobility Plan, Public Communication, Behavioral Change in Transportation.

DESCRIPITON IN SHORT

Creating spaces for walking, cycling, and for children to play freely promotes a healthy lifestyle, reduces traffic's impact on the climate, strengthens the local community, and benefits the local economy. Therefore, the Municipality of Maribor aimed to renovate Glavni trg (Main Square) in the city center. A mobility plan was developed in 2018 to prepare mitigation measures. To analyze traffic network capacity, data from 2015 was used, while considering the projected traffic growth rate. Construction work took place in 2020 and 2021. As a result, Maribor residents gained a renovated 10,000-square-meter promenade.

BACKGROUND

Before the redevelopment, Glavni trg in Maribor was one of the busiest streets in the city center, linking the eastern and western parts of the city. Koroška cesta, which runs along the edge of Glavni trg, was a two-way street with a maximum speed limit of 30 km/h, with more than 15,000 vehicles passing through daily. This area is one of the oldest parts of the city, featuring old, monument-protected buildings that had deteriorated due to excessive traffic. Residents complained about unbearable living conditions and traffic congestion restricted economic activity, both on the road and in the square. Due to excessive traffic, Glavni trg could not fulfill its intended purpose.

The Municipality of Maribor has chosen to follow the example of cities that reclaim their squares and streets for the people. As part of this initiative, Koroška cesta underwent renovation, including the narrower section of Glavni trg and Koroška cesta up to the intersection with Strossmayer Street. The new traffic management approach shifted from separating and segregating users to promoting the shared use of public space.

ELEMENTS

With the renovation, motor vehicle access is now restricted to residents, deliveries, and emergency services with a valid permit, while others are prevented from entering by lifting bollards. There are no designated cycling lanes, as cycling is permitted throughout the entire square, creating a shared traffic space.In the designated area, deliveries and pickups are allowed only during the prescribed delivery window from 6:00 to 10:00. Entry and exit, through the retractable bollard system, require electronic permits, which facilitate automated monitoring and record-keeping.

RELATED MEASURES	To encourage lasting changes in travel habits, a pilot project was implemented, incorporating both incentive and disincentive measures. These were based on temporary road closures and microsimulations to analyze vehicle delays. The project was conducted as part of the LIFE IP CARE4CLIMATE initiative, co-financed by the European LIFE program, and included the development of a mobility plan by the Faculty of Civil Engineering, Traffic Engineering, and Architecture at the University of Maribor. To support the promotion of long-term behavioral shifts, the TAPESTRY model was applied. This model guides individuals through the change process, from raising awareness of traffic-related issues and accepting responsibility for solutions to recognizing alternative travel modes, evaluating options, adopting a new mode of transport, engaging in trial behavior, and ultimately forming new travel habits.
IMPACTS, BENEFITS, NEGLECTED COSTS	The LIFE CARE4CLIMATE project views long-term road closures as an opportunity to transform the target area into a pedestrian zone or a space with highly restricted motor traffic, without causing disruptions in the surrounding traffic network. To minimize congestion and prevent chaotic conditions on the remaining road infrastructure, various measures were implemented within the project. These measures included temporary traffic signalization at intersections, the elimination of left turns, adjustments to traffic signal timing, the extension of green light phases for vehicles, the removal of parking spaces, and the introduction of Kiss & Ride parking areas. As a result, traffic flows were successfully redistributed, with drivers selecting alternative, more time-efficient routes. The mitigation measures related to the closure of Koroška cesta proved effective, as no significant delays occurred during peak morning or afternoon traffic. Additionally, the road closure created extra space for pedestrians and cyclists, further enhancing the urban environment.
SUCCESS or FAILURE FACTORS	Given the significance of changes to the traffic regime, the implemented measures have been continuously monitored through surveys and questionnaires to assess their effectiveness and alignment with public needs. Before the closure of Koroška cesta, respondents were asked whether the road closure in Maribor's city center would influence their travel habits. 72% answered "no," suggesting that it would not reduce car use. However, after the closure, public awareness of the negative impacts of car traffic—such as congestion and pollution—increased. The survey confirmed that closing a road used by up to 16,000 vehicles daily was feasible, with 54.3% of respondents supporting its permanent closure. Despite some opposition from individuals accustomed to driving on this route, the street remained closed to ensure a calm pedestrian-friendly environment. Additionally, an increase in public transport usage was observed, leading to the establishment of new routes to accommodate the growing demand.
OUTLOOK & TRANSFERABILITY	Effective communication with residents is essential for the successful transformation of streets into shared spaces. It is crucial to present challenges, problems, and solutions to the wider public in a clear and professional manner. Shifting the focus from prioritizing drivers to prioritizing pedestrians and cyclists is a gradual process, but the implementation of a mobility plan as a strategic tool for shaping travel habits has proven successful in the case of Koroška cesta. A well-designed mobility plan can contribute to the reduction of greenhouse gas emissions, environmental protection, and the promotion of sustainable travel habits. Additionally, it is vital that the public perceives mitigation measures as effective and beneficial. To ensure the best possible traffic arrangement for all users, these measures must be continuously evaluated, adapted, and improved.

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23. 1. 2025, Version 2

GOOD PRACTICE FACT SHEETS

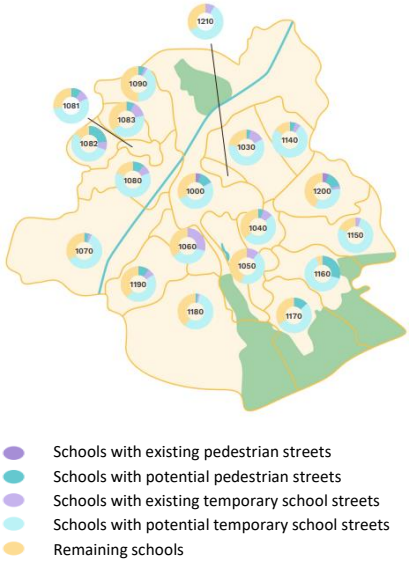
5.13. BRUSSELS SCHOOL STREETS (BELGIUM)

Keywords: Brussels School Streets, Rues Scolaires, Urban Vehicle Access Regulations (UVAR), active mobility, traffic restrictions, school safety, air quality, Vision Zero, Good Move, NO2 reduction, child pedestrian safety, urban planning, sustainable mobility.

DESCRIPTON IN SHORT

Brussels School Streets, or "Rues Scolaires," represent a targeted intervention aimed at enhancing safety and environmental quality around educational institutions. These streets restrict motorized traffic during specific times associated with school drop-offs and pick-ups, creating a safer and more conducive environment for children, parents, and educators. Initiated in 2017, this scheme aligns with Brussels' broader goals of fostering sustainable urban mobility and reducing traffic-related hazards. Distribution by municipality of existing and potential in Brussels Capital Region (map on the Right) →

Distribution by municipality of existing and potential (les chercheurs d'air, 2023)



BACKGROUND

The concept of School Streets in Brussels was introduced under the framework of the regional mobility plan, "Good Move," and aligns with the city's Vision Zero policy, which aspires to eliminate all traffic fatalities and severe injuries by 2030. 56 schools have a school street in the BRC (9%). More specifically, at the moment in the BCR, about 7,5% of schools have temporary LTZ UVARs, 1,4% definitive LTZ UVARs and 2,2% of schools are undergoing pilot projects and experimentation to determine if the surrounding street will be turned into a school street. The legal basis for this initiative is rooted in the "Ordonnance relative à la Mobilité Régionale" of 2016, which provided municipalities with the authority to implement localized traffic restrictions to promote public safety. This policy was driven by alarming statistics: in 2015, over 30% of child pedestrian accidents in the region occurred near schools, underscoring the need for urgent action.

ELEMENTS

Features Brussels School Streets operate by implementing time-bound traffic restrictions. Typically, these restrictions are enforced from 7:30 to 8:30 AM and from 3:00 to 4:00 PM, corresponding to school start and dismissal times. During these periods, motorized vehicles are prohibited from accessing designated areas, except for residents, emergency services, and those with specific permits. Physical measures, such as temporary barriers, bollards, and clear signage, delineate these zones. Enforcement is carried out by municipal police and, in some cases, through automated camera systems.

Temporary School Streets often utilize mobile barriers or foldable bollards, while definitive zones may include permanent fixtures, such as retractable bollards. Traffic signs conform to Belgium's road sign codes, including:

- **C3**: No entry for motor vehicles, with exceptions listed for authorized users.
- **C30**: Zone with restricted access, typically paired with additional panels specifying times.
- **B22/B23**: Mandatory directions for cyclists and pedestrians.
- **F99a**: Pedestrian zones, indicating areas reserved for non-motorized traffic.

Road markings often emphasize pedestrian priority through colorful or high-visibility paint and enhanced zebra crossings. Additionally, urban greening, benches, and lighting upgrades are often integrated into definitive zones to enhance usability and safety.

As of 2023, 43 schools in Brussels have implemented School Streets, and it is estimated that nearly 70% of schools could benefit from such initiatives (*Sudinfo*, 2023). The program's expansion aligns with the "Guide des écoles" by Perspective Brussels, which highlights the importance of integrating urban planning measures with educational needs.

The Brussels Capital Region (BCR) actively supports stakeholders, including school administrations and municipalities, in establishing legal School Streets. This is facilitated through the "Bee École" toolbox.

↑ Rue scolaire rue de la Limite, Saint-Josse.
© Perspective / Marc Detiffe

↑ Exemple de rue piétonne, rue de la Braie à Bruxelles-Ville.
© Perspective / Marc Detiffe

RELATED MEASURES

To enhance the effectiveness of School Streets, Brussels Mobility has implemented complementary measures. These include the expansion of cycling infrastructure around schools, the creation of safe pedestrian routes with pedestrian priority zones, and educational campaigns promoting active travel. Data from Pro Velo indicates that schools with adjacent cycling paths reported a 20% increase in bike usage among students. Additionally, initiatives such as "Les Chercheurs d'Air" emphasize the importance of monitoring air quality improvements, with NO2 levels dropping by 25% in some School Street zones (*Les Chercheurs d'Air*, 2022).

IMPACTS, BENEFITS, NEGLECTED COSTS

Positive Impacts:

- Safety: A 40% reduction in child pedestrian accidents since 2017, making school zones significantly safer for vulnerable users (RTBF, 2022).
- Traffic Volume: A 50% reduction in vehicular traffic during restricted hours, alleviating congestion directly in front of schools.
- Air Quality: NO2 concentrations near School Streets have dropped by 25%, contributing to a healthier environment for children (Les Chercheurs d'Air, 2022).
- Active Mobility: A 30% increase in walking and cycling among schoolchildren, fostering healthier lifestyles.
- Public Support: Surveys indicate 78% of parents and 65% of residents support the initiative, reinforcing its social acceptance.

Negative Impacts:

- Traffic Redistribution: Increased congestion on adjacent roads as vehicles are rerouted, occasionally impacting local residents.
- Accessibility Concerns: Limited access for individuals with disabilities or those requiring vehicular drop-offs.
- Initial Resistance: Opposition from some parents and local businesses due to perceived inconvenience and economic concerns.
- Costs: Implementation costs, including signage, barriers, and enforcement measures, can strain municipal budgets.

SUCCESS or FAILURE FACTORS

Key Success Factors:

- Strong Political Support: Backing from the Brussels Capital Region and alignment with the "Good Move" plan provided legitimacy and resources for implementation.
- Community Engagement: Active participation by school administrations, parents, and local residents fostered a sense of ownership and trust in the project.
- The Bee Ecole toolbox offers : legal guidance, technical assistance, awareness campaigns materials, training workshops processes, monitoring tools, and information on financial support sources.
- Effective Communication: Awareness campaigns and public consultations helped to address concerns and build consensus.
- Tailored Design: Flexibility in implementation, such as temporary vs. permanent measures, allowed adaptation to local needs.
- Monitoring and Evaluation: Continuous data collection on air quality, traffic, and safety ensured evidence-based decision-making.

Challenges and Lessons Learned:

- Public Consultation: Insufficient early engagement in some cases led to resistance, underscoring the importance of inclusive planning.
- Equity Considerations: Ensuring access for all, particularly individuals with mobility challenges, remains a critical area for improvement.
- Enforcement Gaps: Inconsistent enforcement in some areas reduced compliance with restrictions.
- Scaling Efforts: Balancing costs with the goal of expanding to 50% of schools by 2030 requires sustainable funding and resource allocation.

OUTLOOK & TRANSFERABILI

Looking forward, Brussels aims to expand the School Streets program to encompass 50% of the region's schools by 2030. Plans include integrating urban greening and play areas within these zones, further enhancing their utility and appeal. The program's adaptability makes it a valuable model for other cities facing similar challenges. Key recommendations for replication include tailoring the initiative to local contexts, securing political and community buy-in, and employing data-driven approaches to monitor and evaluate outcomes.

MORE INFORMATION

Contact:

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GOOD PRACTICE FACT SHEETS

5.14. VITORIA-GASTEIZ SUPERBLOCKS (SPAIN)

Keywords: *LTZ, superblocks, pedestrianization, calming, cycling, Vitoria-Gasteiz.*

DESCRIPITON IN SHORT

Vitoria-Gasteiz is the capital city of the Basque Country in Spain, a city that has experienced a notable growth during the last decades, circumstances that have not stop the promotion of a sustainable mobility during that time.

Several plans and measures have been taken, and one that can be highlighted is the creation of "supermanzanas" (superblocks) since 2019, where some of the streets have been identified as main ones, while the others remain focused on local and pedestrian movements. It has led to an increase in cyclists and pedestrians, and the reduction of the number of private cars, that produces better traffic situation and less air and noise pollution in those zones. More superblocks and measures are to be created and taken into the future.

Fig. 1. Model of superblocks in the city.

BACKGROUND

The municipality of Vitoria Gasteiz, which comprises 63 surrounding villages, has a total area of 276,81 square kilometers and a population of 253,093 inhabitants, which has increased more than an 11% since 2006.

Since the Sustainable Mobility and Public Space Plan 2008-2023 and the Citizens' Pact that was formed during the preparation of that Plan, the city has already achieved important results in terms of progress towards more sustainable mobility, regarding the city growth of more than 11%, accompanied by the increase in displacements (close to 23%). That growth has occurred in a sustainable way, as journeys by private vehicle have decreased by 8% (from 37% to 29% of total journeys), while bicycle transport (which is already around 9% of total journeys), walking journeys and the use of urban public transport have gained fundamental weight.

As of today – and especially with the new adaptation of the "**Plan for Sustainable Mobility and Public Space 2021-2025**", the ambition of Vitoria-Gasteiz is to advance in new superblocks with public works and pedestrianization of streets and to extend the superblock scheme to the rest of the city center using lane reduction, parking removal, street directions changes and contraflow bicycle ways.

Vitoria-Gasteiz's Sustainable Urban Mobility Plan (SUMP) establishes a network of **main roads** along which all motorized vehicles, either public (bus, tram and taxis) or private can circulate. The aim is to disincentivize the traffic in the rest of the network by separating the main roads from the ones just covered by local traffic in a '**superblock**' model. Superblocks merge the topics of mobility and public space: they are spatial units that define a core network of mobility options at the edge of urban cells and prohibit any motorized traffic except for residents, services and emergency vehicles from entering the cells to stress active mobility and livable public space for people inside the superblocks.

ELEMENTS

A superblock is a set of blocks with "basic" roads along the outer perimeter, on which traffic circulates. The city plan is to be structured into superblocks.

In the interior of the supermanzana (superblock) preference in given to pedestrians and it is accessible to cyclists, service vehicles, emergency vehicles, residents and loading and unloading, at a fixed time.

Apart from that, it includes the transformation of the streets in single platform, which means that everything will be at the same level. Speed will also be limited to ensure the peaceful coexistence of pedestrians, cyclists and drivers.

Initially, residents will be able to park inside the superblock. If and when underground parking is provided, surface parking can disappear.

Apart from that, access to the interior of the superblock can be controlled by different measures. The simplest would involve modifying the direction of circulation, which would discourage rat running. Where this measure is deemed not feasible, access control devices such as automatic bollards (residents would have a magnetic access card) or cameras would be chosen.

RELATED MEASURES

Given the new requirements in Spanish national legislation, the municipality of Vitoria-Gasteiz has kick-started the preparation for a **Low Emissions Zone (LEZ)**. In a first phase, a **Limited Traffic Zone (LTZ)**, corresponding to the Central Superblock, will be implemented, as well as additional measures encouraging active mobility and associated emission reductions.

In later phases, further measures – including **parking regulation** according to the environmental **label of vehicles** - will be implemented to improve air quality and reduce noise pollution in the LEZ.

IMPACTS, BENEFITS, NEGLECTED COSTS

Regarding the studies done, these are some of the **benefits** of this UVAR:

- Increase of number of pedestrians and cyclists.
- Reduce of the traffic congestion and speed, apart from car movements.

Additionally, some further the benefits are:

- Improved road safety, due to reduced speed of cars on the street.
- Decrease of air and noise pollution.

And as the creation of superblocks advances, along with other measures such as LTZ or parking regulations, these benefits will probably improve, even an assessment of the evolution in the traffic and mobility in the city must be undertaken.

SUCCESS or FAILURE FACTORS

The key factors for the **success** of Vitoria-Gasteiz superblocks could be the following:

- Involvement of several stakeholders and political forces (Citizens' Pact) and a longterm guideline to implement several measures, all linked among themselves.
- Improvement of public transport, such as bus and tram.
- Development of a cyclist network and better conditions for its use and pedestrianization.
- Increase of awareness and promotion.

While these measures will have to face some of the following **challenges**:

- Ensuring mobility, especially for low-income households and neighborhoods.
- Coordination between measures and modes.
- Development of the rest of the superblocks planned (total amount of 77) and the LEZ.

OUTLOOK & TRANSFERABILITY

While the model of superblocks is not something completely new in the world, even in Spain (for example, the so called “superilla” or superisland in Barcelona), the vision, implementation and subsequent results in Vitoria-Gasteiz have become a model for other cities to adopt.

Circumstances, such as the road network of the city, the displacements and preferences of the inhabitants and visitors or the public transport should be considered when implementing a superblock model, but the possibilities and benefits have shown that it is an interesting measure to be taken.

Fig. 2. Operation of a superblock.

MORE INFORMATION

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GOOD PRACTICE FACT SHEETS

LTZ

5.15. ALTERNATING TRAFFIC RESTRICTIONS (MAYOTTE)

Keywords : Restricted and Alternating Traffic Zone; License Plate Restrictions; Delivery Vehicles; Reducing Air Pollution; Improving Quality of Life; Overseas; Indian Ocean.

DESCRIPTION EIN SHORT

Since the summer of 2023, the town of Mamoudzou has introduced a system of alternating traffic based on the number plates of cars entering the town. The alternating traffic measure applies from Monday to Thursday on the strategic access routes to Mamoudzou. Vehicles with odd-numbered number plates are allowed to drive on Mondays and Wednesdays, while those with even-numbered plates can enter Mamoudzou on Tuesdays and Thursdays. Certain exemptions apply to residents of Mamoudzou, the emergency and security services, certain professionals, people with reduced mobility and those with special working hours

The authorities are encouraging users to favour alternative means of mobility such as car sharing, shared taxis, shuttles, walking or cycling.

Mamoudzou's alternating traffic order is based primarily on article L.2213-2 of the French General Code for Local Authorities (CGTT), which stipulates that "the mayor may, by reasoned order, in view of the requirements of traffic and environmental protection, prohibit access to certain roads in the built-up area or certain sections of road at certain times or reserve such access, at certain times or permanently, for various categories of users or vehicles".

BACKGROUND

Mayotte is a small French island in the Indian Ocean covering 374 km², and Mamoudzou, the capital, is densely populated, with 71,437 inhabitants in 2017, and is subject to WHO threshold exceedances for air quality. **No fewer than 11,000 people commute to work in Mamoudzou every day. According to government figures, road traffic accounts for 50,000 vehicles entering and leaving the town,** and the roads are not designed to cope with this level of traffic. This volume of traffic is growing steadily with the continuing increase in vehicle registrations, in line with the rise in the motorisation rate of households and the population.

This volume of traffic causes **severe congestion over distances of up to 35 km** at the north and south entrances to the town. This congestion affects:

- Travel conditions and quality of life for the people of Mayotte,
- Access to employment, affecting employee mobility
- Goods vehicle movements,

ELEMENTS

On the main roads in Mamoudzou: passenger cars with odd number plates are only allowed on Mondays and Wednesdays from 5am to 7pm. Passenger cars with even number plates are only allowed on Tuesdays and Thursdays from 5am to 7pm.

The alternating traffic has been accompanied by the introduction of feeder car parks and free shuttle buses operated by CADEMA (the agglomeration community and mobility organising authority).

By way of derogation, this prohibition does not apply to :

- Passenger cars used by residents of all the villages in the Mamoudzou commune;
- Vehicles used by emergency and security service professionals, public service vehicles and medical services;
- Professional vehicles (commercial vehicles, heavy goods vehicles, etc.);
- persons with reduced mobility and accompanying persons driving a vehicle;
- People who can prove that they work hours that straddle several calendar days.

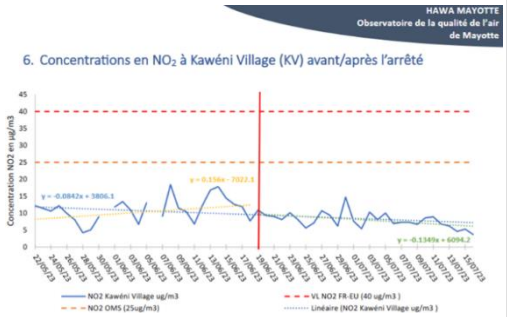
RELATED MEASURE S

At the same time, heavy congestion in Mamoudzou and the surrounding area is set to be exacerbated by the Caribus Bus Rapid Transit project, led by the Urban Community of Dembeni Mamoudzou (CADEMA), which is due to come into service in 2027.

IMPATCS, BENEFITS, NEGLECTED COSTS

Initially, the first assessment of the measure showed a significant reduction in journey times (-15 to -40%) and a switch to bus shuttle, particularly during HPM (morning rush hour), which is consistent with the greater congestion in the direction of the city centre. During the first period of alternating traffic, more than 13,000 passengers took advantage of the free urban bus shuttles provided by CADEMA. The fact that the shuttles were free undoubtedly contributed to its success, but not all the passengers who used the shuttles came from cars (many people switched from taxis to take the free shuttle, which had an impact on the number of full shuttles). The experimental periods of alternating traffic have helped to ease the flow of road traffic, thereby reducing journey times. This improvement in traffic conditions has been acclaimed by the security and emergency services, as well as by socio-economic players. In the case of Mayotte, car traffic remained heavy on even-numbered days, with many vehicles, which meant that the impact of the measure was low on those days.

The Mayotte Air Quality Observatory has carried out an exploratory study following the traffic restrictions. In summary, during the period from 22 May to 16 July 2023, a reduction in PM10, PM2.5 and NO2 concentrations was observed if the average concentrations one month before and one month after the order were compared.
implementation of the order. However, it was also concluded that for PM, the impact of the reduction in traffic due to the school holidays was just as significant as the changeover to the new traffic regulations. For NO2, a 27% reduction in concentrations was observed only in 2023, i.e. as a result of the restriction. In any case, this clearly confirms that the reduction in traffic is having an impact on pollutant concentrations in the Kawéni area.



SUCCESS or FAILURE FACTORS

A public consultation was carried out online in May 2023 before the first experiment: 66% of the 1,100 participants were in favour of introducing alternating traffic and 54% in favour of a 5-day experiment.

Despite this survey, the measure was implemented in a hurry without any real consultation with the entire population. Residents of the south of the island found the measure too discriminatory, as residents of Mamoudzou were not affected. What's more, the restrictions may be seen as too severe/constraining for people who need to get to the airport, do their shopping, etc. Despite the major constraints imposed on motorists, this measure has not been challenged in any major way, even though it has become less effective over time, with far fewer police checks and changes of address on vehicle registration cards (in Mamoudzou) for some of the island's residents.
The summer 2023 restrictions were renewed at the end of 2023 and in 2024. The town of Mamoudzou has carried out an in-depth analysis of feedback on the alternating traffic system in place from 15 January to 7 July 2024. "Constructive discussions with all the socio-economic players and local partners have enabled us to identify the strong points of this system and to envisage improvements".
In an ultra-Marine context where private cars are highly attractive, the relevance of these measures in encouraging modal shift, reducing traffic and congestion, and the acceptance of these restrictions, is questionable. It seems important to assess the impact of the restriction measure by number of plates so that the measure can then be adapted according to need and/or usage. However, during the trial, it was not possible to assess the number of vehicles affected by the measure in Mayotte or to survey the habits of residents.

OUTLOOK & TRANSFERABILITY

In September 2024, the town of Mamoudzou launched a citizens' survey to gather more information on how residents were adapting to the alternating traffic, travel habits, time spent in traffic jams, parking and car-pooling. Following cyclone Chido in December 2024, the measure was discontinued. As a reminder, the same alternating traffic measure was introduced in Paris in 2014 and gave rise to numerous evaluations by the French agency ADEME (Agency for Ecological Transition).

In terms of lessons learned, it is necessary to have a good knowledge of the vehicle fleet (odd/even number plates, craft vehicles and right holders) in order to calibrate the traffic restriction measure. There is a need to raise public awareness prior to implementation and explain the benefits of the measure (reducing congestion and saving time). It is also necessary to coordinate the players involved to ensure the success of the experiment, particularly the importance of the related measures and their financing (P+R facilities, shuttles, monitoring, etc.).

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21.02.2025, Version 3

GOOD PRACTICE FACT SHEETS

5.16. BUENOS AIRES ENVIRONMENTAL AREA (ARGENTINA)

Keywords: Limited Traffic Zone (LTZ), Urban Vehicle Access Regulation (UVAR), Pedestrian Priority, Sustainable Mobility, Congestion Reduction, Air Pollution Control, Metrobus Infrastructure, Shared Streets, Traffic Restriction, Public Transport Optimization.

DESCRIPITON IN SHORT

This Development was carried out in the Microcenter Area of the City of Buenos Aires, which constitutes the CBD (Central Business District) and the main agency of the National Government.. The city is the Capital of Argentina Republic since 1976. It has various actions initiated to reorganize the intense vehicular traffic in the sector. The policy proposed implementing restrictions on the access of private vehicles during central hours and determine Public Transportation routes. This policy continued in successive stages since 2010. The Sustainable Mobility Program in the City included the Pedestrian Priority Plan. The intervention was done in an extended area and has reached estimated 2.6 km^2. The public transportation route was remodeled with a new pavement. The program included the shared use of both pedestrians and mobility (cars, motorcycles, bicycles) and exclusive pedestrian use. In 2013, the installation of the Metrobus on Avda. 9 de Julio was conducted with the estimated circulation of twelve (12) bus line,. based on the construction of a modern infrastructure. The Buenos Aires Central Environmental Area and Automated Attribute Based Access Control (AABAC) Program is being operated which constitutes a UVAR scheme.

BACKGROUND

AABAC program and UVAR development was established from Law No. 5786 of the Legislature (City of Buenos Aires),2016. Thenew schemes for updating UVAR development were proposed as with the following:

.- Goals:

Restrict the use of automobiles, promote the use of public transportation and non-motorized transportation to reduce congestion and pollution.

Restriction:

Motorized vehicles operating hours without entry permit (business days, 11 a.m. to 4 p.m), except emergency vehicles, taxis and authorized vehicles).

Complementary measures in the sector:

- Relocation of public passenger transport lines from internal streets to main avenues.
- Establishment of new streets
- Developments of new Metrobus Transportation System.
- People with reduced mobility, public services, and taxis, as well as emergency vehicles, are exempt.

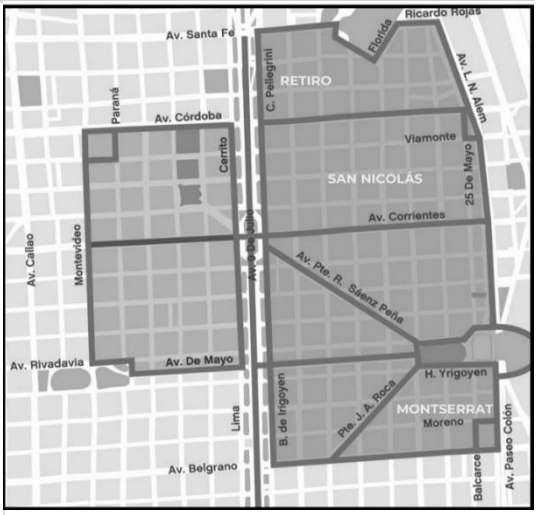

FIGURE N° 1 MAP "AREA AMBIENTAL BUENOS AIRES CENTRO"

ELEMENTS

The vehicle restriction system is applicable during 11:00 a.m. to 4:00 p.m. Figure N°. 2 shows the hourly traffic demand measures on the main avenue in the area.

Intelligent traffic system includes traffic lights control, vehicle movement monitoring and infringement report component.

FIGURE N° 2 Graph of hourly traffic demand measured on the main

RELATED MEASURES

The results of public transportation usage in the Microcenter have given the following result: 37% of streets with vehicular circulation, 37% of exclusive pedestrian streets, 20% of coexistence streets (vehicles and pedestrians) and 6% of green spaces Improvement of Public transportation and a positive environmental impact should be highlighted as a general objective.

Public transportation in general, except the subway, is outside the UVAR Area People travel certain distances on foot along streets with adequate security.

The Region made up of the Micro Centro (UVAR area), Perimeter Zone and Macro Centro, we have the following statistics:

.- High accessibility of public transport: 5 railway terminals, 6 subway lines and 57 bus lines.

.- High concentration of office uses and associated businesses

.- Low density of resident population

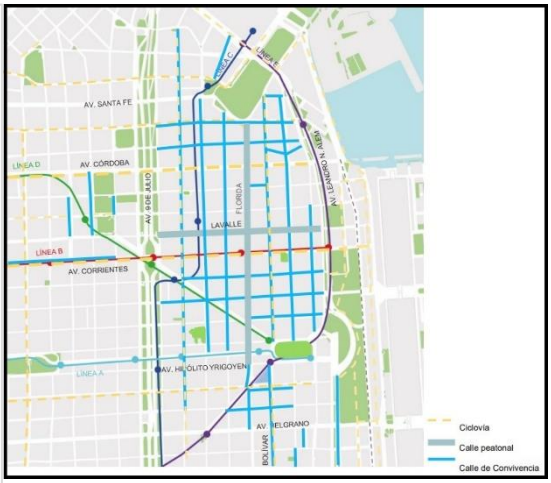

FIGURE N° 3 Map with the use and infrastructure of the Microcenter Zone

IMPACTS, BENEFITS, NEGLECTED COSTS

In addition to the benefits detailed, it is important to highlight some aspects that show a positive evolution in recent years of the UVAR scheme.

.- The area is a sample of the characteristics of the City. There are many hotels and several of them with high-level are attended by national and international tourist. The area provides cultural interest that is diverse (comedy theaters, lyrical theaters and popular and symphonic music.).

.- The infrastructure provides recreational walks and access to restaurants during the day while its unsafe during the night.

Government has a policy to provide night accommodation to homeless people, However, many people sleep on the streets (during the day and at night), .

Consideration should be made for pedestrians and mobility.

SUCCESS or FAILURE FACTORS

Buenos Aires project is a novelty in the City of Buenos Aires since 1976. It remained as the State Policy and continues with new improvements to date.

The project has served as a model for similar projects in all municipalities of the metropolitan region of Buenos Aires, as well as in the rest of the country.

A problem that has been observed in many cases is copying the model and not adequately evaluate the impact that its construction entails. An example of this is that traffic behavior in UVAR's perimeter area that is not adequately studied. Changes may arise from this to optimize urban mobility.

In the case of the City of Buenos Aires, an alteration in land use has been recorded in relation toto the occupancy rate of commercial premises and offices that decreased due to the pandemic and have not been able to recover to previous levels. This has also been influenced by the labor impact of the teleworking methodology.

OUTLOOK & TRANSFERABILITY

Several of the requirements of this point have already been answered.

From the studies of these topics, it is considered that numerous project schemes have emerged in different applications (pavements, road signs, control technologies, legislation,) that can integrate a basic protocol for future works, which has already been verified in this country.

Finally, different areas of the government participate in this type of development and sometimes a lack of coordination is observed in the execution of the works due to non-coinciding professional positions, particularly in land use. That is, the different points of view must be made compatible to guarantee road safety and mobility with spaces dedicated to recreation and other purposes.

MORE INFORMATION
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Author: Oscar Farina (TC 2.1.2 PIARC member) **1.03.2025, Version 2**

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GOOD PRACTICE FACT SHEETS

5.17. TIMIȘOARA PEDESTRIAN CITY CENTER (ROMANIA)

Keywords: pedestrian zone, Timisoara, pedestrianization, public square

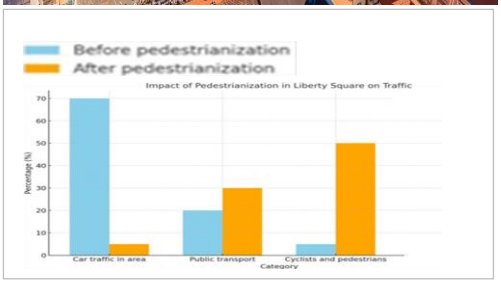
DESCRIPITON IN SHORT

In recent years, Timișoara has successfully transformed its city center into a welcoming pedestrian zone, enhancing both quality of life and environmental sustainability. This initiative replaced traffic-clogged streets with accessible, vibrant public spaces that prioritize pedestrians and cyclists. As a result, the area now fosters greater social engagement, economic growth, and cultural appreciation. Central to this development is Libertății Square, a bustling hub where pedestrians, cyclists, and a passing tram coexist smoothly, creating a unique, lively atmosphere.

BACKGROUND

Before pedestrianization, Timișoara's central area was congested with cars, contributing to pollution and reducing the quality of the urban environment. Narrow sidewalks and limited bike paths made it challenging for pedestrians and cyclists to navigate safely. The municipality aimed to address these issues by creating a pedestrian-centric area that would:

1. **Reduce Environmental Impact**: Vehicle congestion led to high levels of air and noise pollution, harming both public health and the environment.
2. **Preserve Historical Charm**: With fewer cars, Timișoara's historical landmarks could be better appreciated by residents and tourists.
3. **Increase Safety**: The former layout posed safety risks for pedestrians and cyclists due to the volume of vehicles in narrow spaces.
4. **Boost Local Economy**: By transforming the city center into a vibrant, car-free zone, Timișoara hoped to attract more foot traffic and tourism, benefitting local businesses.



Pedestrian only area sign

Tram in Libertatii Square

ELEMENTS

The pedestrianization of Liberty Square in Timișoara involved the implementation of traffic signage solutions to clearly delineate the pedestrian zone and ensure the safety of traffic participants.

1. Prohibition road signs: Signs like "No Entry" or "No Vehicles Allowed" are placed at the entrances to the pedestrian zone to restrict unauthorized vehicle access.

2. Physical barriers and urban furniture: Bollards, planters, or other elements are strategically placed to block vehicle access to pedestrian areas while maintaining an aesthetically pleasing environment.

Implementation

The pedestrianization project was implemented in stages to balance accessibility and logistical needs:

1. **Traffic Diversion and Redesign**: Surrounding roads were reconfigured to direct vehicles away from the center, while access was restricted to necessary delivery vehicles during specific times.
2. **Infrastructure and Green Spaces**: The city center was renovated with quality paving, greenery, benches, and open spaces to make it more inviting. Expanded sidewalks and designated pathways allowed for the safe movement of both pedestrians and cyclist
3. **Increased Bicycle and Pedestrian Pathways**: To promote active transport, additional bike lanes were added in surrounding areas, making the city center easily accessible by bike. Inside the pedestrian zone, bicycles and pedestrians share pathways, which has encouraged healthier lifestyles and more eco-friendly mobility.
4. **Integration of Public Transport**: A notable feature is the tram line that runs through Libertății Square, even with the pedestrian area restrictions. The tram has been seamlessly incorporated into the square, creating a unique environment where public transit coexists harmoniously with pedestrians and cyclists, with no recorded incidents.

IMPACTS, BENEFITS, NEGLECTED COSTS

The transformation of Timișoara's city center has led to several positive outcomes:

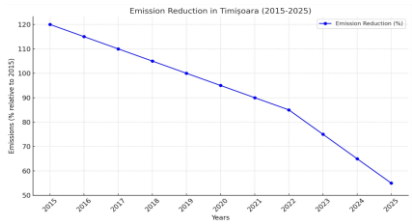
Improved Air Quality and Lower Noise Levels: With a drastic reduction in vehicles, the air quality and overall ambiance have improved, making the area more pleasant and healthier. Local emissions reduced by over 28% as measured. According to recent data, the average levels of these pollutants in Timisoara are as follows: PM2.5 : 12 ug/m3, PM10: 14 ug/m3, NO2 : 11 ppb, O3 : 13 PPB. These values correspond to an Air Quality Index (AQI) of approximately 57, which falls under the "Moderate category"

Increased Bicycle and Pedestrian Traffic: The project has led to a rise in pedestrian 32% and cyclist numbers 11%, as both modes of transport are encouraged and safely accommodated. By allowing bikes and pedestrians to share space without major incidents, the area has become a model of integrated mobility.

Economic Revitalization: With a car-free environment, local businesses in the pedestrian zone have seen increased foot traffic, benefiting from a more inviting and accessible shopping and dining experience.

Safe Coexistence of Transport Modes: The tram continues to pass through Libertății Square, and its presence alongside pedestrians and cyclists has not caused any safety issues. This harmonious integration demonstrates Timișoara's success in creating a multifunctional public space.

Cultural and Community Space: Freed from vehicle congestion, the city center has become a lively venue for cultural events, public gatherings, and social interaction, enhancing the quality of urban life.



SUCCESS

Here are some key success factors for implementing a Low Emission Zone (LEZ) in Timișoara:

- Setting measurable goals, such as reducing air pollution by a specific percentage or decreasing vehicle emissions by promoting cleaner alternatives.
- Educating residents about the health and environmental benefits of the LEZ. Providing clear information on affected zones, timelines, and penalties for non-compliance.
- Expanding and modernizing public transport options, such as buses running on alternative fuels or electric trams. Building bike lanes and pedestrian-friendly zones to encourage non-motorized transportation.

OUTLOOK & TRANSFERABILI

Timișoara's pedestrianization of its city center represents a successful and sustainable approach to urban development. By prioritizing pedestrians, cyclists, and public transit, the city has fostered a safe, accessible, and economically vibrant environment that enhances both local culture and quality of life. The increased presence of cyclists and pedestrians, combined with the absence of incidents involving trams, underscores the effectiveness of this transformation, making Timișoara's city center a model for urban spaces worldwide.

MORE INFORMATION

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Publications:

- http://www.anpm.ro
- https://www.primariatm.ro/
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08.01.2025, Version 2

GOOD PRACTICE FACT SHEETS

5.18. NANTES PEDESTRIAN ZONE (FRANCE)

Keywords: **Pedestrian area, Nantes, bollards, calming, summer pedestrianisation, consultation, ZTL, walkability, festive events**

DESCRIPITON IN SHORT

By 2024, the historic center of Nantes will be home to several pedestrianized areas and one Limited Traffic Zone (France's 1st ZTL, introduced in October 2012).

This represents more than 23km of permanent pedestrianized streets, plus seven (7) streets that are pedestrianized from 15 April to 15 October (day and evening) to encourage local life and commercial appeal. The pedestrian perimeter in the center of Nantes is being extended to include several pedestrian facilities and ZTL is planned for 2025.

BACKGROUND

The aim of Nantes' pedestrian zones is to encourage active modes of transport (walking and cycling), reduce traffic and reduce noise pollution and enhance the city's urban heritage. The city has set a target to increase the transport modal share of pedestrians from 26% to 30% between 2015 and 2030 -Urban Transport Plan (PDU 2018-2027),. Commitment No. 69 of the municipal programme provides for the implementation of new pedestrianized streets.. The metropolitan authority has compiled a Metropolitan Pedestrian Strategy Plan (2018-2027). This indicates the increasing awareness since the Covid-19 crisis on traffic impact in public space (particularly parking). The intention is to improve management of traffic system and promotes pedestrian movements.

At a national level, these initiatives are part of a growing awareness of the risks associated with a sedentary lifestyle. The French National Nutrition and Health Programme recommends 30 minutes of physical activity a day. According to the ONAPS, 30% of men and 50% of women in France do not meet the WHO recommendations for physical activity. Similarly, among children, the share is 37% for 6–10-year-olds, and 73% for teenagers. Active Design initiatives are being put in place to promote walking, which has the advantage of being free and offering numerous benefits for the mind and body.

ELEMENTS

Each entrance and exit to the pedestrian area includes a bollard.Aa bollard with a traffic light, vertical signs and fixed obstacles to close off access. Only vehicles belonging to residents, shopkeepers and certain professionals are allowed access for a maximum of 20 minutes with a badge (ticket for possible police control). In the pedestrian area, motorised vehicles travel at a slow speed. Deliveries are only authorised during specific time slots: delivery button 4am-11.30am and retailers' badge 6am-11.30am. Anyone wishing access and a free badge must apply to metropolice (12,000 badges in use). Badges are renewed every year for trades people, students, tenants and shopkeepers for 2 years and owners for 3 years. Specific cases (hotel customers, moving house, building work) are dealt with using the call button.

Streets that are temporarily pedestrianised for part of the year, barriers are installed and parking is neutralised. Motorists are asked to close the barrier behind them each time a car passes. Shopkeepers are responsible for ensuring that the barrier is closed properly.
A ZTL crosses pedestrian areas from north to south. It is reserved for the same people entitled to use the pedestrian areas, who must display a badge (yellow or purple depending on the zone), and for other authorised users such as public transport, with no time limit.

RELATED MEASURES

Committees made up of shopkeepers and residents have been set up to monitor the pedestrianisation operations and come up with proposals for activities, with financial and technical support from the City and the Metropole. The CHR (cafés, hotels, restaurants) charter, drawn up by the City of Nantes, the Metropole and professional organisations, defines the rules for widening terraces during these periods (by 50% for establishments with a terrace >20m², and 100% for those <20m²), while ensuring respect for pedestrian flows, PRMs and emergency vehicles.

Occasional events include tactical urban planning to highlight pedestrianised streets, as the "Piétonnantes" since 2021 or "Dimanche sans voiture" in 2022 in the Cathédrale Joffre district. In addition, the "Voyage à Nantes" is a 22km green line running through the highlights of Nantes (cultural, architectural, heritage and artistic stages that help to enhance existing pedestrian zones). NB: Tactical urban planning refers to participatory and ephemeral development, carried out by residents or the city, often using art and events.

Since 2020, as part of the pedestrian and cycle plan, the entire city of Nantes has been reduced to 30km/h, except for certain roads used by major public transport lines

IMPACTS, BENEFITS, NEGLECTED COSTS

The metropolis has observed 77,000 accesses to pedestrian areas for the month of November 2021. The modal share of walking has already risen from 21% in 2002 to 26% in 2021 in Nantes.

The retractable bollard system has been upgraded to make it more robust and resistant to vehicle impact.

For 24/7 pedestrian areas to function properly, an agent needs to be available at a control station to monitor the bollards and answer the call button, and on average 1 agent per 20 accesses for repairs, maintenance, equipment and traffic light monitoring.

Compliance with the measures has been good, with few offenders being penalised. To improve understanding at the entrance to the ZTL, a no entry sign has been added at the entrances.

Pollutant emissions were not assessed, as this was not the main objective.

SUCCESS or FAILURE FACTORS

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One-time events are also an opportunity to enhance the identity of each street: barriers and plant containers limit car traffic, while café and restaurant terraces take over parking spaces.

For more information, visit https://naolib.fr/

OUTLOOK & TRANSFERABILITY

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MORE INFORMATION

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GOOD PRACTICE FACT SHEETS

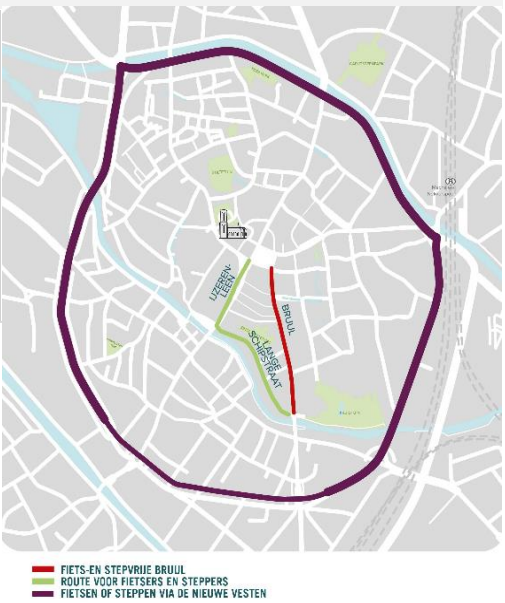
PED

5.19. BRUUL PEDESTRIAN COMMERCIAL STREET (BELGIUM)

Keywords: pedestrian street, commercial street, Belgium, UVAR, shared space, pedestrian and cycling conflicts

DESCRIPITON IN SHORT

The Bruul is a central pedestrian commercial street in Mechelen, Belgium, which has been partially transformed into a more pedestrian-friendly and bicycle-free zone. The initiative aimed to enhance safety, accessibility, and the overall shopping experience while addressing concerns about congestion and mobility conflicts. The pilot project began in the summer of 2023, followed by its permanent implementation in October 2023. Key objectives include improving pedestrian comfort, reducing conflicts between pedestrians and cyclists/step users, and revitalizing the shopping district.



BACKGROUND

Before its transformation into a pedestrian-friendly zone, the **Bruul shopping street** in Mechelen faced challenges typical of busy urban retail streets, such as congestion, limited pedestrian comfort, and insufficient green spaces.

The Bruul project was introduced to address concerns about the safety and comfort of pedestrians in a high-footfall area. Conflicts between pedestrians, cyclists, and step users had become a growing issue, especially during peak shopping hours. Mechelen's urban mobility policy emphasized creating safer, more attractive pedestrian zones as part of broader efforts to make the city center more accessible and sustainable. Following, the city center has seen a steady increase in foot traffic, with unique monthly visitors rising from approximately 275,000 in January 2022 to nearly 300,000 by December 2023.

Relevant legislation included regional and municipal policies prioritizing active mobility and the need for local traffic calming measures. Stakeholder consultations highlighted the need for targeted interventions to ensure the area remained accessible while promoting active and public transport alternatives.

ELEMENTS

Key components of the Bruul project include:

- **Restricted Access:** Cyclists and step users are prohibited from accessing the street on Saturdays and during specific hours throughout the week.
- **Traffic-Free Zones:** The street is part of a larger low-car zone initiative in Mechelen.
- **Technology:** Monitoring systems and enforcement measures include cameras and physical barriers to prevent unauthorized access.
- **Infrastructure:** Improved pedestrian pathways, public seating, and aesthetic upgrades, including planters and better lighting.
- **Signage:** Clear demarcation of pedestrian-only areas and zones where bicycles and steps are restricted.
- **Enforcement:** Regular monitoring and fines (128 fines issued during the pilot phase) to ensure compliance.

RELATED MEASURES

- A new **underground parking facility** was created to free up surface space, transforming the area into an attractive and greener pedestrian zone.
- **Public Awareness Campaigns:** Informing residents and visitors about the changes and their benefits through public signs and posters.
- Mechelen sets up “Hoppinpunten”, mobility hubs serving as the backbone for the transition to sustainable urban mobility.
- **Improved support for sustainable transport modes**
  - Shared cars: increase from 81 to 184 vehicles.
  - Shared car users: from 2,177 to 3,023.
  - Shared bikes: from 150 to 571, including 9 electric cargo bikes.
  - Shared electric scooters: introduction of 200 units.
- Moreover, in September 2020, 29 partners signed a “covenant” in Mechelen, pledging to reduce logistics emissions in the city to 0% by 2030, in line with EU directives.

IMPACTS (Pros & Cons)

Impacts:

- Bruul records approximately 390,000 pedestrian visits each month, which highlights an improved pedestrian safety and comfort. This increased foot traffic induces increased business activity, especially during car-free Saturdays.
- Moreover, the reduction in conflicts between pedestrians, cyclists, and step users strengthens the subjective safety feeling within the Bruul public space.
- In 2018, Bruul was named Belgium's most beautiful shopping street, winning the Public Space Award. The jury praised its transformation into a pleasant pedestrian zone with added greenery and water features, setting a benchmark for other cities.
- Reflecting economic activity, electronic payments in Mechelen increased from just over 600,000 in January 2022 to nearly 800,000 by December 2023.
- **Declining Vacancy**: Despite economic challenges, Mechelen has experienced a decrease in retail vacancy rates, with the number of occupied commercial properties increasing, demonstrating the resilience and attractiveness of the city's retail sector.

Neglected Costs:

- There was a slight initial resistance from cyclists and step users due to restricted access, especially on Saturdays.
- Increased enforcement costs.
- There is a potential inconvenience for local deliveries and businesses during restricted hours.

SUCCESS FACTORS

Success Factors:

- Strong municipal leadership, collaboration with businesses, and public communication as this measure was adopted only after widely positive feedback from businesses and residents.
- Gradual implementation through a pilot phase to test and refine the approach.

Failure Factors:

- Resistance from certain stakeholders, such as cyclists and step users.
- Challenges in ensuring consistent enforcement.

Lessons Learned:

- Engaging stakeholders early can help mitigate resistance.
- Phased implementation allows for adjustments and increases public acceptance.

OUTLOOK & TRANSFERABILITY

The Bruul project serves as a model for medium-sized cities aiming to enhance pedestrian zones while managing urban mobility conflicts. Future developments include: (1) Expanding the low-car and pedestrian-friendly zones to other streets in Mechelen, (2) Exploring innovative solutions for managing delivery access, (3) Integrating real-time monitoring technologies for better enforcement.

Key conditions for success include: (1) Strong political commitment, (2) Robust stakeholder engagement, (3) Availability of alternative transport solutions and infrastructure, (3) Effective enforcement mechanisms.

MORE INFORMATION

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Publications:

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GOOD PRACTICE FACT SHEETS

5.20. MEDINA OF TUNIS (TUNISIA)

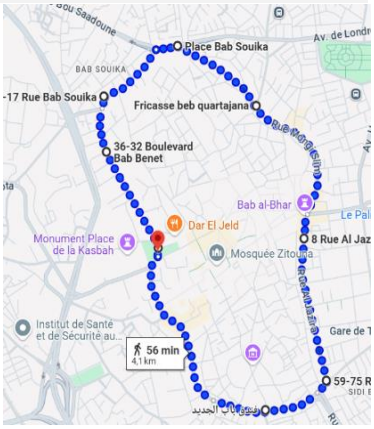
Keywords: **Pedestrian zone, walkability, historic area, attractiveness, appeasement**

DESCRIPITON IN SHORT

The medina of Tunis, the city's historic quarter, is a jewel of Arab Muslim urban planning. It combines economic, residential and heritage functions with more than 700 monuments. Its morphology and the width of the road networkwhich has little access for cars and open to pedestrians and Non-motorised transport. The Ez Zitouna Mosque is the starting point for the creation of the medina to date since the end of the 7th century. The road network made up of through lanes and dead ends, is unsuitable for traffic other than pedestrians.

A large underground car park with a capacity of 1,200 cars 24 hours a day,

located under the Place de la Kasbah on the outskirts of the Medina and was built in the 1980s to meet everyone's parking needs.



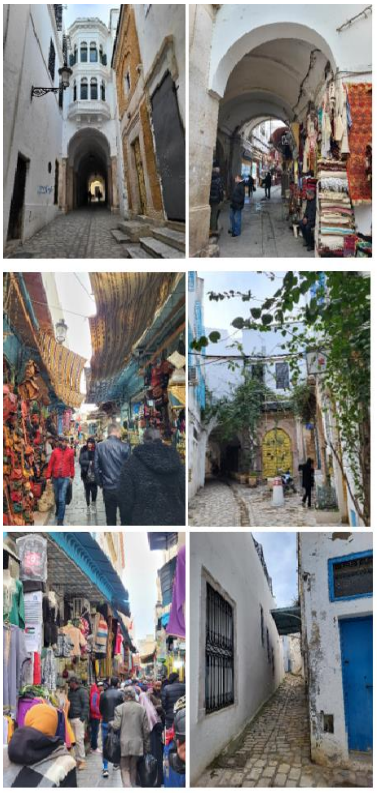
BACKGROUND

The medina of Tunis is an Islamic medina, the historic heart of Tunis, which has since been listed as a UNESCO World Heritage Site. It has a surface area of 100 hectares and a population of 16,000 as of the 1st of January 2024. The medina accounts for 2.6% of population of the city of Tunis and less than 0.5% of its urbanised area. Urban planning in the Tunis medina is unusual it does not follow the geometric standards.

The medina is surrounded by walls, with seven gates, two of which are still visible today, Bab el Bahr and Bab Jdid. These walls have been demolished and replaced by roads that allow traffic to flow around the Medina. Inside these walls is a network of roads based on two main axes, the rue Jama'a (Mosque) Ez Zitouna and the rue de la Kasbah and their extensions, connected to narrow streets and dead ends.The medina is a highly dynamic area, where residential and business areas coexist, with the heritage and cultural aspect superimposed on top.

The morphology of the Tunis medina resembles the old town centres of European cities. The street layouts are tangled and do not follow any geometric standards. They are angular, winding and narrow. reflecting the traffic conditions that prevailed when the medina was founded. For example, rue Jama'a Ez Zitouna, which is 3 metres wide at the entrance to the medina, varies in width along its entire length, as projections reduce its width. And this is the case for all the streets in the medina, some of which are less than a metre wide!

Residents have blocked off the street by adding a room to their dwelling, thus turning the street into a dead end. Similarly, they may build a vault (sabbat) over the street, on the sole condition that this does not obstruct traffic. This is a specific feature of Muslim urban law, which allows the "air" of the street to be used as property for building. The notion of public space is therefore ambiguous in the case of the medina, where streets are an extension of houses and subject to social guidelines.

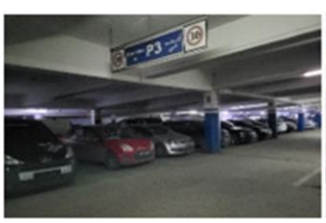


ELEMENTS

Because of the way the medina is laid out, car traffic is virtually impossible. There is no car traffic plan, but certain roads, which are sufficiently wide and relatively straight, are used by cars. This is a tolerated form of traffic. Most of the time, cyclists, pedestrians and cars live together harmoniously. Cyclists don't get on their bikes. Deliveries are made by "portefaix" (porters) using handcarts or hand trucks throughout the day. The porters criss-cross the main shopping streets, hailing pedestrians to clear the way when pedestrian traffic is very heavy. The delivery system is managed by the municipality, which grants permits. In the evenings, the Medina cleaning service, managed by the Municipality of Tunis, sweeps and collects rubbish. A special service is responsible for collecting waste from cafe-s and restaurants, with a specific collection fee.

RELATED MEASURES

A large 1,200-space underground car park, open 24 hours a day, 7 days a week, solves the parking problem for users and residents of the Medina and the surrounding area. Users can take out monthly season tickets, either for two periods (6am-1pm and 1pm-8pm) or 24 hours a day. A low-cost package is available for residents and shopkeepers in the medina.




The Medina has been a UNESCO World Heritage Site since 1979, and the “Association de Sauvegarde de la Medina” has set up a series of signposted tourist routes to showcase the town's remarkable buildings. Several festivals are organised in the medina (musical or theatrical evenings, exhibitions in historic buildings, etc.) attracting visitors and bringing the medina to life.

IMPACTS, BENEFITS, NEGLECTED COSTS

The pedestrianisation of the medina makes it an attractive area for Tunisians and tourists alike. The nuisances associated with car traffic (pollution, noise) are non-existent.

The main streets are very busy: rue Jama'a Ez Zitouna is the main thoroughfare for tourists (strolling, souvenir shopping) and rue de la Kasbah, the second busiest thoroughfare, mainly attracts Tunisians. Pedestrian traffic is very heavy all year round. Outside these main thoroughfares, pedestrian traffic is much less dense and tends to be devoted to local shops. And on these secondary roads, the cohabitation of pedestrians, cyclists and possibly cars create no problems, despite the narrowness of the alleyways. The streets are often cluttered with goods stored directly on the public space.

Because of the tranquillity, peace and security that characterise the medina, many homes are being converted to restaurants and hotel activities.

SUCCESS or FAILURE FACTORS

The pedestrianisation of the medina does not cause any major problems, apart from the congestion and jostling between pedestrians, given its strong appeal. During the day, the medina continues to attract more and more people, attracted by the peacefulness and special atmosphere it exudes. In the evening, however, the shopping streets empty out with only the residential areas remaining somewhat lively. The harmonious cohabitation between the different users of the medina has led to an increase in pedestrian traffic, which in turn has generated profits for shopkeepers. To stimulate activity, and to meet the demands of shopkeepers, it would be worthwhile delaying the closing time of shops, as happens during the last fortnight of the month of Ramadan.

Car traffic is restricted to a few wide streets, but this only happens occasionally. The ban on car traffic is well understood by locals and tourists alike, even though there are no road signs. There are only a few bollards to block the way.

The car park, which serves the needs of both the inhabitants of the medina and those working in the various ministries concentrated in the upper part of the medina, could do with some improvement in terms of layout. This dark, poorly ventilated area is little used at night.

OUTLOOK & TRANSFERABILITY

Over the centuries, the pedestrianised medina has resisted the redevelopment of the area (with wide roads for cars). And it is a success! The fact that these historic facilities have been preserved is becoming a very modern, even avant-garde posture for today's UVARs.

The dynamism and growing attractiveness of the medina are inspiring planners who have decided to pedestrianise other areas of Tunis (rue de Marseille, a road perpendicular to Avenue Bourguiba, which has seen a resurgence in businesses thanks to this pedestrianisation). It would be interesting to see the pedestrianisation of Avenue Habib Bourguiba as well as the perpendicular roads to make the city centre a "car-free" zone! From time to time, the Avenue is pedestrianised on Sundays; it would be a good idea to make this a permanent feature.

The same observation applies to other towns in Tunisia, and even Mediterranean towns that include a historic medina: these completely pedestrianised, traffic-free areas are proof that a town centre can remain dynamic and attractive, by restricting the flow of cars. The Avenue Hedi Chaker in Sfax, for example, has become a great place to stroll and create events.

Nevertheless, consideration must be given to deliveries and a suitable car park nearby to meet the parking and logistics needs of these pedestrianised areas.

MORE INFORMATION
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Publications:
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https://whc.unesco.org/fr/list/36/cartes/

GOOD PRACTICE FACT SHEETS

5.21. QUÉBEC PARKING SCHEME (CANADA)

Keywords: Parking, pricing by weight, parking permit, UVAR

DESCRIPITON IN SHORT

This is a project located in a area of the city of Montreal called Rosemont La Petite Patrie. The project aims to adjust the pricing of on-street parking permits based on the type of vehicle. The classification of vehicles is determined by the net weight indicated on the registration certificate and their belonging to one of the following two categories:

- **Green registration class**: fully electric vehicles, hydrogen fuel cell vehicles, or plug-in hybrid vehicles;
- **Blue registration class**: internal combustion vehicles or non-plug-in hybrid vehicles.

The price of the parking stickers according to the size of the vehicle's engine. Generally, the more gas your vehicle consumes, the more expensive the sticker. However, as of July 1, 2023, a new pricing system for parking stickers has been implemented, based on vehicle weight. The main objective of this regulatory review was to develop a new segmentation of the vehicle fleet that would make it possible to internalize vehicle properties that have a proven real impact on on-street parking capacity.

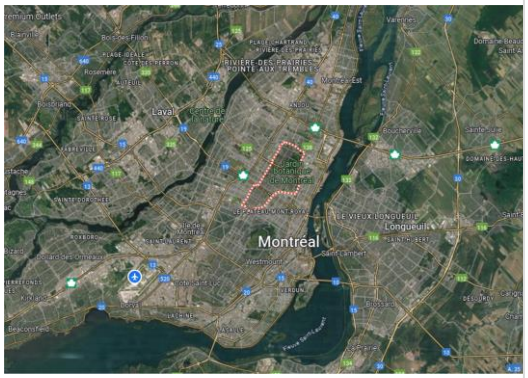
BACKGROUND

Montreal's vehicle fleet has undergone significant transformation over the past two decades. These transformations can be summed up as follow : The triple growth in the number, volume and mass of vehicles. This is reflected in the space occupied by vehicles and on-street parking capacity.

The proportion of sports utility vehicle (SUV) has jumped by 189.7%. In 2021, they accounted for 41.4% of the Montreal fleet, a proportion 2.3 times higher than 20 years ago. As a result, the loss of on-street parking spaces due to the progressive increase in vehicle volume would be between 10% and 25%. Applied to the Rosemont-La Petite-Patrie area, this would represent a potential loss of 4,000 to 10,000 spaces.

The city is trying a new approach by encouraging its residents to choose smaller vehicles, which would increase parking space on its streets. The standards regarding on-street parking are enforced by the city or municipality, which has the authority to amend the applicable regulations. It is the municipal council of the city or municipality that adopts regulatory changes.

This new pricing was well received by the local population and there was no resistance to this regard.



Map locating the Rosemont borough.

ELEMENTS

The bill rises to $217 for vehicles weighing over 1600 kg. Owners of electric or plug-in hybrid vehicles won't escape, but in their case, the categories will be a little different. The bill will be $125.32 for vehicles weighing less than 1699 kg, rising to $497.84 for those weighing 2500 kg or more. It will cost $687.55 to obtain a sticker for a second vehicle, regardless of weight. Costs will be limited for people with reduced mobility and low incomes.

Model sign for parking with sticker.

RELATED MEASURES	The parking stickers are limited to two per civic address with this new regulation
IMPACTS, BENEFITS, NEGLECTED COSTS	The aim of this UVAR is to ensure that the cost of parking correlates with the space taken up by the vehicle, and by doing so to encourage people to buy smaller vehicles. Ultimately, the aim is to encourage the population to adopt active modes of transport and reduce dependence on the automobile. We see this measure as a good first step towards restricting car use and encouraging other mobility options. Above all, this measure discourages households from owning a 2nd car. We believe that this initiative should primarily increase the cost of permits for gasoline vehicles. Since this adjustment is based on weight and mass, and electric vehicles are often much heavier, this initiative doesn't significantly negatively impact gasoline vehicles. No impact or unforeseen event was observed after the start of the project.
SUCCESS or FAILURE FACTORS	This new initiative was very well received by the local population. When revising these regulations, consideration should be taken to account for low-income households as well as the size of households.
OUTLOOK & TRANSFERABILITY	This measure could be implemented in any territory where on-street parking is reserved for residents.The measure has already been implemented in other areas of the city of Montreal. Parking management officials from the city of Paris met with the initiator of this measure in the Rosemont borough of Montreal to draw inspiration from it. The main recommendation to improve this measure is to work towards ensuring that the length of the vehicle is available in the registration records, as this information is currently unavailable in Quebec. Indeed, since parking is primarily a matter of linear meters, the length of the vehicle could be the sole variable considered to determine parking rates. In the absence of this data, a proxy using the vehicle's weight has been employed

MORE INFORMATION

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Publications:

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GOOD PRACTICE FACT SHEETS

5.22. LYON PARKING PRICING SCHEME (FRANCE)

Keywords: [street parking policy], [reduce air pollution, improve quality of life], [less space consuming vehicles], [electric vehicles], [bulky and impactful vehicles], [social rate parking] [modal shift]

DESCRIPTION IN SHORT

The City of LYON in France is pursuing a proactive policy of transition in mobility to meet the urgent need for action on climate change, air pollution, road safety and better sharing of public space. In this context, the municipality has decided to change its parking policy by summer 2024.
The aim is to encourage the use of less polluting and less space-consuming vehicles in public spaces. Parking charges are higher for heavy vehicles.

This new progressive parking pricing system in Lyon was approved by the city council on March 21 and was implemented from Tuesday June 11, 2024.

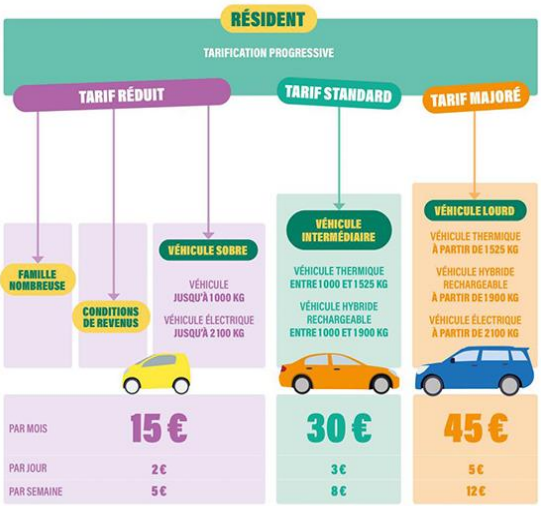
BACKGROUND

Lyon is adapting its on-street parking policy to ensure better sharing of public space, as part of its overall health policy and in response to the climate emergency. **The new pricing system encourages the use of vehicles that pollute less and take up less public space. It also introduces greater social justice by considering the social and family criteria of Lyon's motorists.** For professionals, the municipality is proposing special rates that are more accessible and easier to use than current business rates. To enable the implementation of this new parking policy, the City of Lyon has decided to propose a move to a single pricing zone to simplify the process for users.

ELEMENTS

The new pricing system has been introduced for both visitors and residents. It is both environmentally friendly and supportive, considering the financial and family situation of residents to ensure greater social justice. For resident season tickets, large families (3 or more dependent children) and those on low incomes (brackets <= 3 of the municipal family quotient, i.e. a reference tax income per unit per year of less than €13,800) automatically benefit from a solidarity and family rate of €15 per month, instead of €20 per month. **The social factor takes precedence over the type of vehicle used: the city estimates that this concerns almost one out of every two households in Lyon, and 60% of Lyon families.**

This pricing system will also be progressive, based on the overall impact of vehicles on the environment and the occupation of the public domain. It will take account of the vehicle's type of engine and weight, the two criteria used by the French government to apply the car tax on new cars. These criteria will also be applied to hourly rates for non-subscribers, who will be offered the rate corresponding to their vehicle at the time of payment by retrieving this data from the SIV (Vehicle Registration System) file.



TARIF VISITEUR HORAIRE

TARIFS VISITEURS	RÉDUIT Véhicules <1 000 kg ou électriques	Tarifs Actuel Tempo	STANDARD	Tarifs Actuel Presto	MAJORÉ Véhicules >1 525 kg à vide ou hybrides rechargeables >1 900 kg ou électriques >2 100 kg
1h	1€	1€	2€	2€	3€
2h	3€	3€	6€	11€	9€
4h	12€	16€	14€	29€	21€
7h	18€	25€	26€	47€	39€
10h/FPS	35€	35€	55€	60€	80€
Répartition estimée des véhicules	20 %		65 %		15 %

RELATED MEASURES

Article L.2333-87 of the French General Code of Local Authorities stipulates that on-street parking rates may be adjusted according to the duration of parking, the surface area occupied by the vehicle or its impact on air pollution. It may also provide for specific rates for certain categories of user, and be reduced according to the user's income level, status or number of people living in the household.

IMPACTS, BENEFITS, NEGLECTED COSTS

This policy, which responds to the issues raised by the Citizens' Climate Convention, aims to encourage the use of smaller or low-emission vehicles. It is based on technical information on vehicle engine and weight. **For example, resident subscriptions :**

- electric vehicles automatically benefit from the reduced rate of €15 per month, to help combat air pollution, except for bulky, high-impact vehicles (over 2,100kg). Low-income families and households also benefit, whatever their vehicle, as do combustion-powered vehicles weighing less than 1,000kg (small city car category).
- The standard rate of €30 per month will apply to internal combustion vehicles weighing between 1,000 and 1,525 kg, as well as plug-in hybrids weighing up to 1,900 kg.
- **The most bulky and impactful vehicles will have to pay the increased rate of €45 per month. These include internal combustion vehicles weighing over 1,525 kg, plug-in hybrids weighing over 1,900 kg and electric vehicles weighing over 2,100 kg.**

In addition to this new progressive pricing system for residents and visitors, the City of Lyon is also proposing a change in parking charges for professionals (urgent repairs, pro worksite, pro craftsman/trader). The aim of all these schemes is to facilitate the use of a vehicle when the nature of the work most justifies it, as is the case for professionals who provide care, services and work in the homes of Lyon residents or for Lyon businesses.

Advantages: parking charges are at the crossroads of several issues: mobility, by encouraging modal shift; the use of public space, to share it better; environmental issues, by encouraging fewer polluting vehicles; and social issues, by helping those on the lowest incomes. The aim is to enable the city to function better, and to improve the quality of life of the people of Lyon.

SUCCESS FACTORS

There has been little feedback on measurement and acceptability, as these operations are recent.

OUTLOOK & TRANSFERABILITY

After Lyon, it's the turn of Paris to introduce, from October 1, 2024, a parking fee based on vehicle engine and weight. Voted for by the Paris Council in May 2024, a combustion vehicle weighing more than 1,600 kg, or an electric or hybrid weighing more than 2,000 kg, will see its hourly parking rate triple. As a result, parking a heavy vehicle for 1 hour in the central arrondissements of Paris will cost €18, compared with €6 for a light vehicle.

Who is concerned by this measure? All visitors, i.e. users with no specific parking rights (residential, professional, low-emission vehicle or Handi'Stat).

Which vehicles are affected? In the firing line: SUVs (sport utility vehicles), which are often taller, larger and heavier than the average light vehicle.
How will vehicles be checked? Vehicles will be identified and recognized thanks to their registration number and the SIV system (vehicle registration system) introduced in April 2019.

THE DEVELOPMENT OF SOLIDARITY-BASED PRICING:

Several French cities offer their residents special parking rates that take income levels into account. Examples include Nantes, Chambéry, Lille, Strasbourg, Clermont-Ferrand and Valenciennes.

MORE INFORMATION

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Publications:
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Author : Sandrine ROUSIC FRANCE (member of PIARC TC 2.1.2)

21.02.2025, Version 2

PIARC

GOOD PRACTICE FACT SHEETS

LOR

5.23. STRASBOURG DELIVERY LEZ (FRANCE)

Keywords : **Restricted traffic zone, time restrictions, delivery vehicles, reduce air pollution, improve quality of life, protect heritage, development of river delivery and cargo bikes, ZFE.**

DESCRIPTION IN SHORT

On 1st September 2018, in Strasbourg city centre, a **restricted traffic zone (ZCR) was introduced to reduce traffic and parking for delivery vehicles,** by banning the most polluting vehicles, limiting vehicle weights and reducing time slots. This is part of a wider set of measures, including a pedestrian zone (in orange) on the « Grande Ile" and a Zone Low Emission Mobility covering the whole of Strasbourg's Eurometropole (33 communes), which has restricted access to certain vehicles based on Crit'Air stickers since 1st January 2022. **As a result of these restrictions since 2019, a river logistics platform coupled with cargo bikes has been developed for deliveries in the city centre.**

BACKGROUND

This project addresses the various challenges linked to the increase in deliveries (particularly due to clothing collections and e-commerce):

- Air quality (NOx and fine particles; in 2021, the new WHO criteria placed the entire Strasbourg Eurometropole in a zone where the 10 µg/m³ NO_2 threshold will be exceeded).
- Quality of life (sense of insecurity for the elderly and families with children, lack of space for shopkeepers' terraces, inaccessible streets, residents' expectations for concrete action on climate change).
- Heritage preservation (e.g., hewn cobblestones, space occupation).
- Traffic flow improvement, better coexistence between transport modes, and easier deliveries.

This **Restricted Traffic Zone (ZCR)** aligns with the Mobility Orientation Law (December 24, 2019), the decree of September 16, 2020, on Low Emission Zones (LEZs), and the Climate and Resilience Law (August 22, 2021).

At the ministerial committee on urban air quality on July 10, 2023, the French government clarified the obligations for implementing LEZs, which has several consequences for urban logistics in cities.

ELEMENTS

The urban logistics strategy was developed jointly by the local authority and local stakeholders from 2015 onwards (in 2017, it was estimated that the city centre accounted for almost 8% of delivery activity for the entire conurbation, covering just 0.3% of its surface area, and that service by commercial vehicles and HGVs contributed to 18% of road Nox emissions). **Since 1st September 2018, restrictions have been inplace on the movement and parking of delivery vehicles**. Enforcement is carried out by the municipal police (fine 11euros).
Deliveries are permitted from 6am to 10.30am (or until 11.30am for "clean" natural gas or electric vehicles). The maximum tonnage is reduced from 19T to 7.5T unless an exemption is granted. Deliveries by bicycle or on foot are always permitted.
In 2019, ULS (Urban Logistic Solutions) will be operating the Fischerstaden quay as a logistics platform **for waterway services with cargo bikes for the last few kilometres.**

Since 2021, this has meant that up to 122 tonnes of goods can be brought into the city centre goods (equivalent to 150 vans fewer on the roads) in 27 minutes. 15 cargo bikes distribute the goods around the city centre. This includes flour, parcels, beer barrels, building site equipment in one direction and recyclable waste (up to 48T) in the other direction.

RELATED MEASURES

At the same time, as part of the ZFE, all vehicles must display the sticker on their windscreen to drive and park in the Eurometropole. In addition, subsidies, exemptions and a 24-hour pass - which can be used 24 times a year simply by calling the Climate Agency - are available.

Currently, no penalties are applied; non-compliant drivers are simply informed. From 2026, manual checks will be carried out by the national and municipal police forces. Eventually, automated checks will be introduced using cameras.

Fines will be set at €68 for light vehicles and €135 for heavy goods vehicles.

MPACTS, BENEFITS, NEGLECTED COSTS

Few people were familiar with the rules governing deliveries and the measure was an opportunity to raise awareness among residents and shopkeepers. Several comprehensive guides, aimed at residents and outside are on Eurometropole website.

Urban have encouraged logistics regulations the development of deliveries by cargo bike, as they are permitted all day long.

The cargo bike offers an alternative that is less polluting, quieter and takes up less space. However, the development of cargo bikes has which have not yet been properly analysed: their size can make it difficult to with pedestrians, and it is not possible to other bicycles, and for cargo bikes to travel on the ground.

As a result, some towns have chosen to ban them from certain streets. An analysis and regulation of the traffic plan for cargo bikes must be considered in each case.

SUCCES or FAILURE FACTORS

The city says it is very satisfied with the results of river delivery combined with cycling. This project has enabled us to make the most of the river, which was largely underused. To achieve this, it was necessary to develop suitable infrastructure (a warehouse downstream and a quay in the centre of the city), ensure good coordination between the players involved in order to consolidate flows, and have a strong policy and political support with the ZFE. Last-mile delivery by river is still little known in France, and we need to look at its real impact in terms of pollution, air quality and urban operation.
Aid for professionals has been introduced: aid for purchase or hire (up to €1,000 for a cargo bike, up to €6,000 for a small LCV, €10,000 for a vehicle between 3.5 and 7.5 tonnes, up to €15,000 for a heavy goods vehicle, capped at 40% of the purchase price excluding VAT), aid for conversion (including compliance). These grants can be combined with those from the State and the Region.
Each year, the number of vehicle classes is restricted. Each time a new Crit'Air sticker comes into force in France, a one-year education phase is introduced to help people adapt without incurring financial penalties. The initial schedule was as follows:

However, the ban on Crit'Air 3 has been postponed until 2027, given the improvement in air quality that has been observed. In 2024, the EPZ will be maintained despite the improvement in air quality, but in a largely educational form due to the absence of the automatic control tools promised by the government.

OUTLOOK & TRANSFERABILIT

The example of Strasbourg shows that restricting HGV traffic in the city, combined with the development of river deliveries using bicycles, is a success. Other initiatives to facilitate 'last mile' logistics using waterways are currently being developed by the Strasbourg metropolitan authority, such as a platform near a shopping area in Vendenheim.
This type of river transport was developed in Lyon in 2022, followed by Paris, Rouen and soon Mulhouse.

MORE INFORMATION :

Contact :

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Publications :

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Author : Sandrine ROUSIC FRANCE (member of TC 2.1.2 PIARC)

21.02.2025, Version 3

GOOD PRACTICE FACT SHEETS

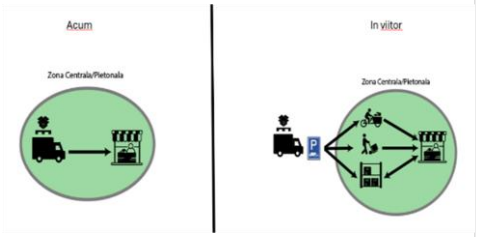
5.24. TIMISOARA DROP-OFF POINTS (ROMANIA)

Keywords: urban logistics, drop-off point, lorry access restriction, pedestrian zone

DESCRIPITON IN SHORT

In Timișoara, Romania, the city's planned project for establishing drop-off points aims to enhance urban logistics and reduce congestion by strategically positioning delivery zones close to the city center. The primary benefit of this initiative is that delivery vans will no longer need to enter the pedestrian area, preserving the pedestrian-friendly environment while maintaining efficient logistics. Positioned within a five-minute walk from central merchants, the planned 20 designated spots are calculated to meet the delivery demands of over 300 city-center businesses. The project will be implemented in summer 2026 after consultation with business and citizens.

Figure 1 Drop-off point concept

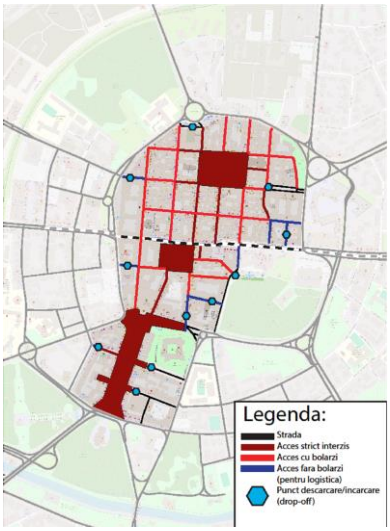


BACKGROUND

Complaints in Timisoara regarding delivery congestion have been reported, especially due to the increase in delivery volumes and the heavy traffic infrastructure. The city center has faced logistical challenges, particularly regarding short-term parking for delivery vehicles serving central merchants. Without dedicated drop-off zones, delivery vans often entered pedestrian-only areas, creating congestion and disrupting the pedestrian-friendly atmosphere. Other key issues included:

1. **Limited Access to Short-Term Parking**: Delivery drivers frequently struggled to find available spaces close to the city center, resulting in delays and operational inefficiencies.
2. **Low Turnover in High-Demand Zones**: A lack of enforced time limits led to extended occupancy, blocking spaces for subsequent deliveries and exacerbating congestion.
3. **Inaccurate Monitoring and Limited Compliance**: Previous monitoring systems were unable to accurately track parking times, making enforcement difficult and reducing parking turnover.

The drop-off points project addresses these issues, with a primary focus on maintaining the pedestrian area's accessibility while providing reliable short-term access for logistics.



ELEMENTS

The project's core objectives aim to balance logistical efficiency with pedestrian accessibility:

- **Reducing Delivery Van Traffic in Pedestrian Zones**: By positioning drop-off points within a convenient five-minute walking radius, the project aims to eliminate the need for vans to enter pedestrian areas.
- **Providing Efficient, Short-Term Delivery Access**: With an estimated 20 dedicated spots, the system will provide timely access for deliveries while reducing congestion in the city center.
- **Increasing Turnover for Greater Accessibility**: Short-term time limits will encourage rapid parking turnover, ensuring that spaces are continuously available for quick unloading.
- **Improving Monitoring Accuracy**: Real-time sensors and cameras will monitor parking durations, enforcing compliance and ensuring that spaces are used efficiently.

Implementation

Key steps in planning the project have focused on meeting both logistical and urban design goals:

1. **Strategic Placement Near City Center**: Drop-off points will be located within a short five-minute walk from central merchants, ensuring logistical convenience while preserving pedestrian zones. Calculations suggest that 20 parking spots will adequately support the delivery needs of 300 merchants.
2. **Advanced Monitoring and Time Limit Enforcement**: Sensors and cameras will track the duration of vehicle stays to prevent overstays and maintain high turnover.
3. **Progressive Pricing for Overstays**: A progressive pricing model will incentivize drivers to comply with time limits, reducing the risk of prolonged occupancy.
4. **Public Awareness for Merchants and Drivers**: Information campaigns will educate merchants and delivery providers on the benefits and regulations of the new drop-off points, encouraging cooperation.

IMPACTS, BENEFITS, NEGLECTED COSTS

Although the project is still in planning, several positive outcomes are anticipated:

1. **Reduced Vehicle Traffic in Pedestrian Zones**: The primary benefit will be removing delivery van traffic from pedestrian areas, maintaining the city center as a safe, pedestrian-friendly environment.
2. **Enhanced Efficiency for Central Merchants**: With drop-off points in close proximity, delivery efficiency is expected to improve, allowing merchants timely access to goods without delays.
3. **Higher Turnover Rates for Delivery Vehicles**: Enforced time limits and pricing will encourage rapid parking turnover, freeing spaces for continuous deliveries.
4. **Increased Traffic Flow and Decreased Congestion**: The new system will reduce the need for double-parking and improve the overall flow in the city's busiest areas, benefiting pedestrians and drivers alike.
5. **Improved Compliance and Monitoring**: Advanced technology for timing and tracking parking durations is expected to yield accurate enforcement, enhancing turnover and space availability.

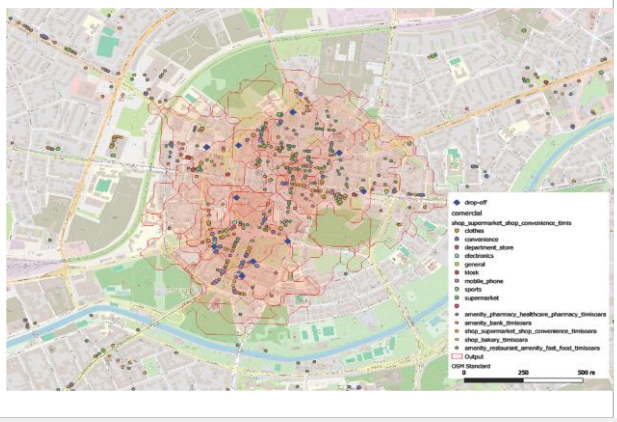
SUCCESS or Failure FACTORS

Potential barriers for drop-off in Timisoara:

1. Infrastructure: Heavy traffic, lack of parking, roadworks
2. Regulations: Restrictions in central areas, special fees
3. Technology: Lack of advanced tracking or smart lockers
4. Behavior: Users poorly informed or preffering other methods
5. Accessibility: Too few drop-off points, limited operating hours
6. Economic/Social factors: High costs, low digital adoption

OUTLOOK & TRANSFERABILITY

By establishing drop-off points close to the city center, Timișoara is set to improve urban logistics while keeping its pedestrian areas accessible and safe. Anticipated benefits include greater delivery efficiency, better traffic flow, and most importantly, the elimination of delivery van traffic from pedestrian-only zones. This project demonstrates how strategic logistics planning can support both urban commerce and pedestrian-friendly spaces.



MORE INFORMATION

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Publications:

http://www.traficmedia.ro

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Author: Mihai Florescu(TC 2.1.2 PIARC member) **08.01.2025, Version 2**

GOOD PRACTICE FACT SHEETS

5.25. TIMIȘOARA'S HEAVY VEHICLE ACCESS SCHEME (ROMANIA)

Keywords: Lorry Ban / Delivery Time Windows, Pollution reduction, congestion mitigation, urban safety improvement, sustainable mobility, environmental protection, Heavy vehicle traffic, reduced heavy vehicle presence in urban core, imișoara, Romania

DESCRIPITON IN SHORT

Timișoara, a vibrant city in Romania, will implement an innovative approach to manage heavy vehicle traffic through its Urban Vehicle Access Regulation (UVAR) project. This initiative seeks to reduce the negative impacts of truck traffic—such as pollution, congestion, and safety hazards—by regulating access to urban areas. The UVAR project employs a progressive pricing structure for trucks, encouraging compliance with designated weight limits and discouraging the entry of oversized vehicles into restricted areas. The result is a safer, cleaner, and more sustainable urban environment.

BACKGROUND

The increase in truck traffic through Timișoara's urban areas create significant challenges, including:

Pollution: High levels of air and noise pollution affected the health and well-being of residents.
Congestion: Trucks added to peak-hour traffic, reducing efficiency for public and private transport.
Infrastructure Strain: Heavy vehicles accelerated road wear, leading to higher maintenance costs and potential safety issues.
Safety Concerns: Pedestrian and cyclist safety was compromised due to the presence of trucks in areas with high foot traffic.

Timișoara's municipality will develop the UVAR project, aimed at balancing the needs of urban logistics with those of sustainable urban living. This project will be implemented in early 2026 after consultation with business and citizens.

Push and Pull Measures for Restricting Heavy Vehicle Access in Timisoara

Push Measures	Pull Measures
1.Access restriction and transit fees parking areas	1. Building bypass roads and truck
2.Strict fines for non-compliance	2.Promoting rail and waterway transport
3.Limiting access during specific times routes	3. Intelligent system for alternative
4.Reducing city entry points	4.Reduced fees for bypass road use

ELEMENTS

In Timisoara, authorities implement various technologies to monitor compliance with urban access regulations, contributing to efficient traffic management and improved urban living quality.

1. CCTV Surveillance Systems: Surveillance cameras are strategically placed in restricted access areas to monitor traffic and identify vehicles violating the regulations.
2. Traffic Sensors and Wireless Networks: To optimize urban traffic, Timisoara has implemented wireless sensor networks that monitor vehicle flow and traffic conditions.
3. Digital Platforms and Mobile Applications: The municipality has developed online platforms and mobile apps that allow citizens to report traffic-related incidents or violations of access regulations.
4. Urban Regeneration Projects and Smart Infrastructure: Timișoara is investing in urban regeneration projects that include the implementation of smart solutions for traffic management and access monitoring.

By integrating these technologies, Timișoara is strengthening its status as a smart city focused on innovative solutions for traffic management and ensuring compliance with urban access regulations.

Implementation

The UVAR project is implemented through the following restrictive measures:

1. **Strictly Defined Restricted Zones**: High-priority areas with pedestrian activity, including the city center, were made fully off-limits to trucks.
2. **Restrictive Route Designation**: Truck routes were strictly limited to specific, outer-city perimeter roads, ensuring heavy vehicles avoid high-density and residential zones entirely. This restrictive approach minimizes truck presence in inner-city areas and redirects them to bypass Timișoara's core.
3. **Time-Restricted Access for Deliveries**: Essential deliveries are allowed during designated off-peak times, such as early mornings and midday, ensuring minimal disruption to urban flow.
4. **Traffic Monitoring and Compliance Enforcement**: The Traffic Management Center monitors `compliance rigorously through surveillance cameras and smart sensors.
5. **Progressive Pricing Structure for Weight Limits**: A pricing model with higher fees for heavier vehicles was introduced, creating a financial deterrent for oversized trucks while encouraging lighter trucks for urban deliveries.

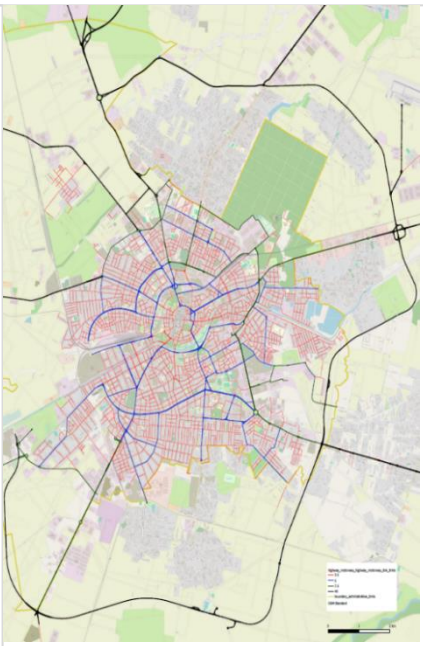
The implementation of urban access regulations in Timișoara has led to a significant reduction in traffic congestion. For example, the eastern radial road (parallel to Calea Lugojului/DN6) significantly reduced congestion. In the "business as usual" scenario, vehicle flows would have increased in almost all sections by 2030. Implementing alternative scenarios led to decreased vehicle flows on the city's existing streets, thereby contributing to reduced congestion.

IMPACTS, BENEFITS, NEGLECTED COSTS

The outcomes of the UVAR project are promising:

1. **Improved Air Quality and Reduced Noise**: With truck traffic heavily restricted in the city center, pollution will decrease, leading to a healthier environment. From estimates PM 10 fall by 32%.
2. **Reduced Traffic Congestion**: Restrictive routing removes trucks from urban areas by 10%, enhancing the flow of public and private traffic within Timișoara.
3. **Enhanced Pedestrian and Cyclist Safety**: The absence of heavy vehicles in pedestrian-dense zones increases safety, encouraging active mobility.
4. **Preserved Infrastructure**: Reduced heavy vehicle traffic in the city center has minimizes road wear, lowering maintenance costs.
5. **Positive Economic Impact**: Businesses will adapt by using appropriately sized vehicles, which has supported local compliance while ensuring essential goods delivery.

Between 2010 and 2014, the number of registered vehicles in Timisoara increased by 18%, from 165,869 to 195,878. This growth significantly contributed to traffic congestion in urban areas.



SUCCESS FACTORS

In Timisoara, the barriers related to urban access regulation have been addressed through a combination of financial, administrative, social and infrastructural measures. The implementation of these solution required collaboration between local authorities, the private sector, and citizens, ensuring a more efficient and sustainable urban access regulation process.

OUTLOOK & TRANSFERABILITY

Through a restrictive routing approach, Timișoara's UVAR project demonstrates how strategic access control and progressive pricing can promote safer, more livable cities. By balancing urban logistics with environmental goals, this project serves as a model for cities looking to manage heavy vehicle impacts effectively while enhancing quality of life for residents.

MORE INFORMATION
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PIARC

GOOD PRACTICE FACT SHEETS

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5.26. URBAN FREIGHT DISTRIBUTION AND ACCESS IN FEZ

Keywords: Urban Freight Distribution (UFD), Strategic UVAR Planning, UVAR, Congestion, Fez

DESCRIPITON IN SHORT

The case study on **Urban Freight Distribution (UFD)** in Fez highlights the absence of formal regulations concerning designated spaces and schedules for loading and unloading operations. This lack of regulation negatively impacts the city's economic competitiveness, particularly in comparison to suburban shopping centres. The primary objective is to enhance the efficiency and cost-effectiveness of distribution to prevent business relocations. The study underscores the importance of **strategic UVAR planning** (Urban Vehicle Access Regulations) to integrate UFD into urban mobility policies, especially as the number of delivery vehicles increases by 5% annually.

BACKGROUND

Urban Freight Distribution (UFD) in the city of Fez is characterized by a notable lack of regulation. This includes gaps regarding designated spaces for this mode of transport, permitted times for loading and unloading on public roads, and inadequate organization of deliveries. The few reserved spaces that do exist are mainly located in parking areas regulated by the municipality.

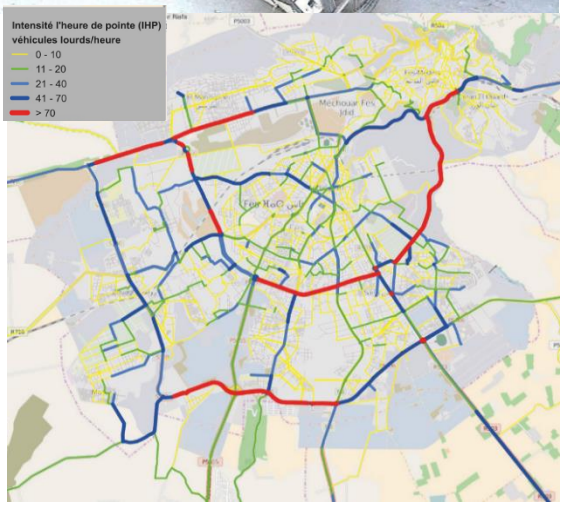
The regulation of **Urban Freight Distribution (UFD)** in Fez is crucial for several reasons. It can support the economic competitiveness of urban areas and the medina by preventing businesses from relocating to the outskirts. Additionally, it helps mitigate environmental issues and congestion caused by the increasing traffic resulting from the widespread use of three-wheelers, vans, and carts. These challenges negatively affect both the quality of life for citizens and overall traffic flow.

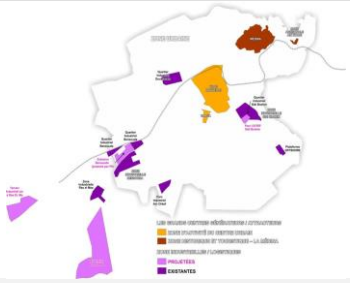
ELEMENTS

Mobility demands associated with Urban Freight Distribution (UFD) in Fez are linked to two fundamental aspects:

- **Economic and industrial activity centres** function both as storage and sorting areas and as distribution origins. These logistics centres serve as starting points for deliveries to businesses scattered throughout the city centre and peripheral neighbourhoods.
- **Small and medium-sized businesses** represent the final destinations in the distribution chain.

Each of these zones must be addressed differently, considering the nature of their activities. For example, a business located in the old medina differs significantly from one in the urban centre or a peripheral neighborhood.





The **major traffic-generating and attracting areas** associated with the distribution of consumer goods and raw materials include: **industrial zones** covering **364 hectares** on the outskirts, the **urban center**, which is a major **commercial area spanning 400 hectares** requiring constant supply, and the **Medina**, a **historic center and high-density zone** extending over **235 hectares**, requiring **special management** to preserve its cultural heritage.

The **prefecture of Fez** has a population of **1,256,172 inhabitants**, according to the **2024 census**. The number of **trucks and vans** (weighing **3.5 tons or less**) is estimated at **50,000**, making Fez the **third-largest** city in this category, after **Casablanca and Rabat**. This type of vehicle represents **more than 83%** of the **heavy goods vehicles (HGVs)** used for **Urban Freight Distribution (UFD)**.

RELATED MEASURES

Incentive Measures:

- Development of Dedicated Spaces: Creating specific zones for loading and unloading in commercial and industrial districts would help reduce congestion.
- Smart Technologies: Implementing traffic management systems, such as delivery slot reservations, would optimize routes and prevent traffic jams.
- Subsidies for Eco-Friendly Vehicles: Encouraging the use of low CO_2 emission vehicles through subsidies or tax incentives would lower the environmental footprint.

Deterrent Measures:

- Access Restrictions: Limiting delivery vehicle access to central areas, such as the Medina, during peak hours and regulating parking duration would improve traffic flow.
- Tolls for Heavy Vehicles: Introducing tolls for large vehicles would encourage more efficient and environmentally friendly delivery methods.

IMPACTS

When the proposed measures are fully operational, combined with the goal of reducing private vehicle (PV) use by 20% and increasing public transport (PT) usage by 60%, the **evaluated environmental impact** indicates a **60% reduction in projected CO_2 emissions** compared to a baseline trend scenario. Additionally, this strategy is expected to result in **fuel savings of 124 million liters**, translating into a **financial gain exceeding 150 million euros**.

SUCCESS or FAILURE FACTORS

Success Factors:

- Logistics Growth: The average annual growth rate of heavy goods vehicles (HGVs) associated with Urban Freight Distribution (UFD) is 5%, reflecting an increased distribution capacity that boosts the economy.
- Adaptability: Transport operators have successfully adapted to logistical constraints by using vans to circumvent traffic issues typically faced by heavy trucks.
- Economic Impact: UFD has strengthened the competitiveness of local businesses, particularly in industrial zones such as Ain Chkef and Ben Souda.

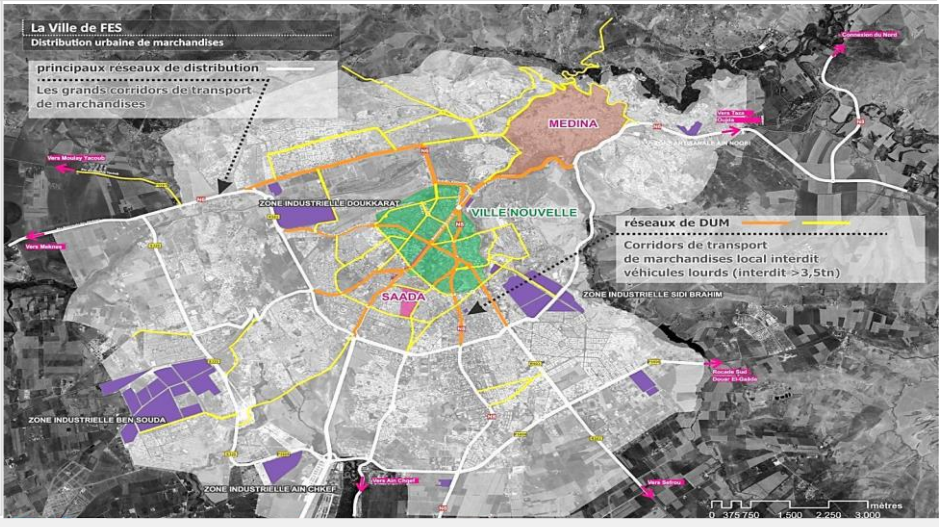
Failure Factors:

- Lack of Regulation: The absence of formal rules for distribution (e.g., designated zones and schedules) has led to traffic congestion and deterioration of urban infrastructure.
- Lack of Coordination: The lack of collaboration between key stakeholders (government, transport operators, and merchants) has hindered effective management of UFD traffic.
- Unadopted Technologies: The absence of innovative technologies, such as traffic management systems and surveillance cameras, has worsened congestion and prevented the enforcement of penalties.

OUTLOOK & TRANSFERABILITY

Urban Freight Distribution (UFD) must be integrated into an UVAR policy, adapted to the urban context, to efficiently manage freight flows, minimize environmental impact, and maintain the city's socio-economic competitiveness.

A definition of the network designed to accommodate heavy traffic is presented below:



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Publications:

Maaroufi, M.M., Stour, L., Agoumi, A. (2022). Sustainable Mobility Model for Fez City (Morocco). In: Motahhir, S., Bossoufi, B. (eds) Digital Technologies and Applications. ICDTA 2022. Lecture Notes in Networks and Systems, vol 455. Springer, Cham. https://doi.org/10.1007/978-3-031-02447-4_10.

Maaroufi, M.M., Stour, L., Agoumi, A. (2022). Sustainable Mobility Plan Indicators: Application to the Moroccan Case. In: Motahhir, S., Bossoufi, B. (eds) Digital Technologies and Applications. ICDTA 2022. Lecture Notes in Networks and Systems, vol 455. Springer, Cham. https://doi.org/10.1007/978-3-031-02447-4_11.

GOOD PRACTICE FACT SHEETS

5.27. GHENT'S LORRY ACCESS REGULATIONS (BELGIUM)

Keywords: Urban logistics, LEZ, time-window restrictions, freight transport, air quality, ANPR enforcement, last-mile delivery, circulation plan

DESCRIPTON IN SHORT

Ghent's Urban Vehicle Access Regulations (UVARs) for lorries are integral to its progressive traffic and mobility strategies. The city introduced a comprehensive **Circulation Plan** in April 2017, aiming to reduce vehicular traffic in the city center, optimize urban logistics, and improve environmental quality. Building upon this, a **Low Emission Zone (LEZ)** was established on January 1, 2020, further restricting access based on vehicle emission standards. Complementing these measures, time-window regulations for lorries manage freight access during peak hours (7:00–10:00 and 16:00–19:00), promoting cleaner and more efficient delivery methods. Collectively, these policies position Ghent as a leading example of sustainable urban logistics in Europe.

BACKGROUND

Ghent's UVAR initiatives are driven by ambitious climate action goals and the necessity to address urban challenges such as congestion, pollution, and noise. As a participant in the European Union's **Covenant of Mayors**, Ghent has committed to reducing CO_2 emissions by 40% by 2030. Prior to 2017, the city experienced significant through-traffic in its medieval core, leading to elevated levels of nitrogen oxides (NO_x) and particulate matter (PM2.5). Studies indicated that over 25% of vehicular emissions were attributable to freight transport. Legislative frameworks, including the **Flemish Air Policy Plan (2016)** and Ghent's own **Climate Plan (2015)**, provided a foundation for implementing UVAR measures. Extensive public consultations were conducted to shape the Circulation Plan, ensuring broad support for its implementation.

ELEMENTS

The Ghent UVAR policy includes several integrated measures aimed at regulating freight and lorry access while improving urban logistics and environmental quality. Time-window restrictions limit access for lorries exceeding 3.5 tons during peak hours (7:00–10:00 and 16:00–19:00) to reduce congestion and enhance road safety. Exceptions are granted for electric and low-emission vehicles that meet Euro 6 standards or higher. Additionally, the Low Emission Zone (LEZ), in place since January 1, 2020, applies stringent access rules within the city ring road (R40). Diesel vehicles must meet at least Euro 5 standards, while petrol vehicles must comply with Euro 2 standards. By 2025, only Euro 6 and electric vehicles will be permitted within the zone, which operates 24/7 and affects all freight categories, including N1 (vans < 3.5 tonnes), N2 (light trucks between 3.5 and 12 tonnes), and N3 (heavy goods vehicles over 12 tonnes).

Enforcement relies on Automatic Number Plate Recognition (ANPR) technology, which monitors compliance in real-time. Non-compliant vehicles are subject to automated fines ranging from €150 to €350. To minimize disruption and optimize freight operations, Urban Consolidation Centers (UCCs) on the outskirts facilitate last-mile deliveries via electric cargo bikes and low-emission vans, reducing the need for heavy lorry traffic in the city center. Additionally, on-site inspections and GPS data from logistics operators complement ANPR enforcement, ensuring compliance. In 2022 alone, over 50,000 violations were recorded and fined. To facilitate compliance, operators can verify their vehicle status through Ghent's online registration tool, where they may need to register, obtain a permit, or purchase a day pass if their vehicle does not meet emission standards.

Certain exemptions apply within the UVAR framework. Essential services, such as waste collection vehicles operated by IVAGO, are granted access to restricted areas. Two-wheelers, including electric bikes, cargo bikes, and class A and B mopeds, can enter streets closed to motorized vehicles, although class B mopeds may require a permit. Temporary exemptions are also available for specific needs, such as construction activities, subject to prior approval. These mechanisms ensure that while Ghent enforces strict environmental and traffic regulations, it maintains flexibility for essential urban functions.

RELATED MEASURES

Complementary initiatives associated with the UVAR policy include:

- **Pedestrianized Zones:** The Circulation Plan expanded car-free areas, creating safer and more accessible public spaces.
- **Subsidies for Cleaner Vehicles:** Incentive programs encourage operators to transition to electric or hybrid delivery vehicles. As of 2023, 30% of freight vehicles servicing the city were electric.
- **Dynamic Delivery Scheduling:** Digital platforms allow operators to book delivery slots, optimizing access during permitted time windows and reducing congestion.

IMPACTS, BENEFITS, NEGLECTED COSTS

Between 2017 and 2022, NO_x emissions dropped by 20%, and PM2.5 levels fell by 18% due to reduced high-emission lorry traffic (Stad Gent, 2023). Since the LEZ implementation in 2020, more than 30% of freight vehicles have transitioned to electric or hybrid models, contributing to lower carbon emissions and reduced noise pollution (LEZ Belgium, 2023). The 2017 Circulation Plan has helped cut through-traffic by 35%, improving public space for pedestrians and cyclists (York Civic Trust, 2024). Urban Consolidation Centers (UCCs) have further enhanced logistics efficiency by shifting last-mile deliveries to cargo bikes and low-emission vans, while dynamic delivery scheduling has optimized freight access to the city, minimizing congestion during peak hours (Stad Gent, 2023).

Despite these benefits, challenges remain, particularly for small and medium-sized freight operators who face high costs for compliance, including retrofitting vehicles or purchasing new low-emission trucks (York Civic Trust, 2024). Larger logistics companies have adapted more easily, but SMEs struggle with the financial burden. Additionally, the €10 million investment in ANPR enforcement infrastructure, while effective, requires continuous operational funding (Stad Gent, 2023). Some logistics operators have also raised concerns about rigid time-window restrictions, which may not always align with supply chain demands (LEZ Belgium, 2023). Ensuring long-term economic sustainability for freight carriers remains a key challenge as Ghent expands its UVAR framework.

SUCCESS or Failure FACTORS

The success of Ghent's lorry regulations is largely attributed to strong enforcement mechanisms, stakeholder engagement, and technological integration. ANPR cameras and automated fines ranging from €150 to €350 have ensured high compliance, minimizing unauthorized entries (Stad Gent, 2023). The introduction of UCCs on the city's outskirts has provided a practical solution for logistics companies, enabling last-mile deliveries via cleaner vehicles (LEZ Belgium, 2023). Public consultation with freight operators and SMEs before implementation also helped secure support, making the transition smoother (York Civic Trust, 2024). The time-window restrictions, which limit lorry access during peak hours, have successfully improved safety and mobility for all road users, ensuring heavy goods traffic does not interfere with public transport and pedestrian-friendly areas (Stad Gent, 2023).

However, lessons learned highlight areas for improvement, particularly in supporting SMEs. The city should consider financial incentives or phased regulations to help smaller operators transition to compliant vehicles (York Civic Trust, 2024). Additionally, better coordination with regional and national freight networks could help resolve logistical challenges related to inconsistent access restrictions between Ghent and other municipalities (LEZ Belgium, 2023). A data-driven approach to policy adjustments, using ANPR data and freight movement trends, could refine time-window restrictions to balance efficiency and sustainability without disproportionately impacting businesses (Stad Gent, 2023). Despite these challenges, Ghent's approach provides a replicable model for urban freight management, demonstrating how targeted lorry regulations can reduce emissions, optimize logistics, and enhance urban liveability.

OUTLOOK & TRANSFERABILITY

Ghent's UVAR policies continue to evolve, with planned expansions of the LEZ and stricter emission standards by 2030. The city is exploring AI-based traffic management systems to further optimize freight operations.

The transferability of Ghent's UVAR model depends on other cities approach to their unique urban layouts and logistics demands, other cities and grants can encourage compliance in regions with lower economic capacity, active participation from all stakeholders ensures practical and equitable solutions.

Ghent's experience offers valuable insights for cities seeking to balance environmental, economic, and mobility objectives. Its integrated approach demonstrates how urban areas can achieve sustainable logistics while fostering public and stakeholder support.

MORE INFORMATION

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Publications: ***Stad Gent (2023)*** **on Low Emission Zone and urban mobility policies in Ghent,** ***LEZ Belgium (2023)*** **on compliance, enforcement, and future regulations, and** ***York Civic Trust (2024)*** **on lessons from Ghent's circulation plan for sustainable urban mobility. Additionally, the** ***Flemish Government (2016)*** **provided insights from the Flemish Air Policy Plan, while the** ***Covenant of Mayors for Climate & Energy (2015)*** **outlined Ghent's commitment to reducing CO_2 emissions by 40% by 2030.** ***Transport & Mobility Leuven (2018)*** **evaluated Ghent's circulation plan and its effects on freight transport, and the** ***European Commission (2019)*** **contributed findings on urban freight transport and low-emission zones. The** ***Polis Network (2022)*** **analyzed the role of time-window restrictions in urban logistics, and the** ***Belgian Road Safety Institute (2020)*** **assessed the**

GOOD PRACTICE FACT SHEETS

5.28. CASABLANCA LORRY LANES (MOROCCO)

Keywords: Smart Mobility, Dynamic Lane Management, Heavy Goods Vehicles (HGVs), Heavy Trucks, Dedicated Lanes or Reserved Lanes

DESCRIPITON IN SHORT

The separation of heavy goods vehicle (HGV) traffic coming from the Port of Casablanca towards the Zenata dry port from the urban traffic using the coastal road is a concrete UVAR case study. It provides a solution to the problems caused by HGV traffic while avoiding full or partial grade separation of the roads. This low-cost alternative, implemented for the first time in Morocco in 2024 by SDL Casablanca Aménagement, is based on the use of Intelligent Transport Systems (ITS). It enables the management of goods flows through smart mobility and dynamic lane management, with a positive impact on business competitiveness, citizens' quality of life, and the city's environment.

BACKGROUND

The increase in heavy goods vehicle (HGV) flows, either to or from the Port of Casablanca, on urban roads intensifies congestion, causes road surface deterioration, worsens various nuisances and pollution (noise, air, and visual), contributes to the consumption of public space, and increases the mortality risk for vulnerable road users. Simultaneously, the presence of industrial and commercial clusters in the city center, often associated with storage functions, generates high demand for transport and parking.

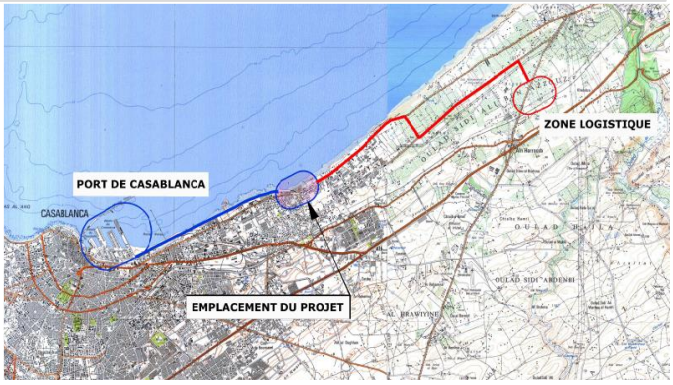
Given this context, diverting HGV flows away from the city center via the coastal road presents a major urban planning challenge and is crucial for enhancing business competitiveness, improving the city's attractiveness, increasing citizens' quality of life, and ensuring road accessibility and safety.

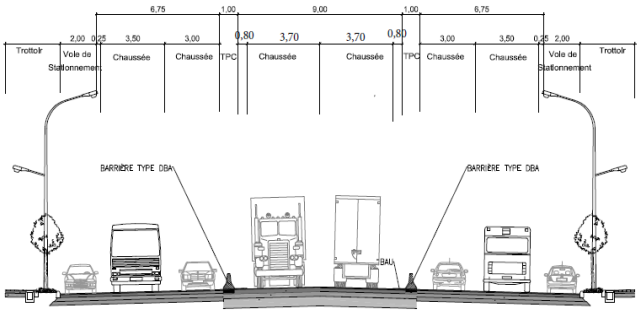
The Average Daily Traffic (ADT) on the coastal road toward the Zenata Logistics and Industrial Zone (ZLMF) is 21,000 vehicles. Peak hour (PH) traffic reaches 3,300 vehicles in both directions, with 10% comprising 13-meter-long HGVs. The daily container HGV traffic amounts to 3,200 vehicles, while non-container HGVs related to port activities account for 5,600 vehicles transiting both ways. The peak hour design traffic includes 1,100 HGVs, of which 36% are 13 meters long and 64% are 17 meters long.

ELEMENTS

The design of dedicated lanes for heavy goods vehicles (HGVs) must meet the following requirements:

- **Minimal impact** on land expropriation and network relocations.
- **Urbanistic and functional compatibility** with the adjacent Corniche Ain Sebaa project.
- **Smooth pedestrian access and safety** for those heading to the beach.
- **Separation of port and urban traffic** to reduce congestion and conflicts.
- **Sufficient capacity** to accommodate HGV traffic demand.
- **Uninterrupted operations** for HGV traffic in case of accidents.
- **Safe and dynamic traffic management** at intersections.
- **Travel time optimization** to enhance the logistics zone's competitiveness.
- **Improved traffic flow and increased capacity** on urban roads.
- **Unrestricted traffic flow** during construction, with minimal disruptions.
- **Limited maintenance** of infrastructure and equipment.
- **Compliance with the allocated project budget.**





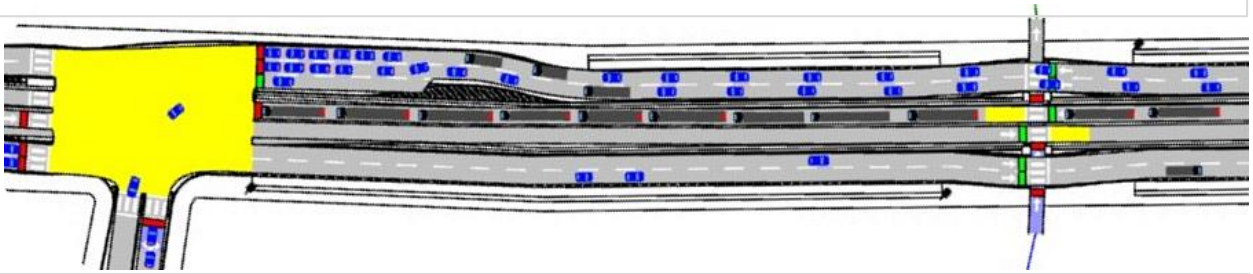
Following a multi-criteria analysis, the variant presented above meets the previously established requirements.

RELATED MEASURES

The intelligent traffic signal intersections are programmed as follows:

- **Cycle duration:** 80 seconds.
- **Main axis priority:** The main axis remains green for at least 45 seconds to accommodate the flow of 550 HGVs per hour in each direction.
- **Left-turn (LT) and secondary road phases:** Activated upon request with 8-second green phases.
- **Vehicle detection:** Sensors are installed at LT lanes and secondary roads to detect vehicle presence, allowing the system to exit the main phase rest state when needed.

A **saturation loop system** and early closure of traffic signal phases are implemented to replicate the "Yellow Box" effect, preventing gridlock at intersections.
Pedestrian crossings are served during LT and secondary road phases. Pedestrians on secondary roads are served during the main phase. **Pedestrian detection devices** are used to reduce waiting times by shortening green phases for vehicles when no approaching vehicles are detected.



IMPACTS, BENEFITS, NEGLECTED COSTS

The regulation of heavy goods vehicle (HGV) traffic between the Port of Casablanca and the Zenata dry port, through the dedicated HGV lane on the coastal road, will divert over **13,000 HGVs per day** from the city center by the end of 2025. This initiative will address the following :

- **Relieve the city's main roads**, improving both traffic flow and road safety.
- **Leverage Intelligent Transport Systems (ITS)** to collect historical traffic and incident data, enabling real-time traffic management, ongoing monitoring, and post-implementation effectiveness evaluation.
- **Shorten HGV travel distances and times**, enhancing working conditions for drivers, improving the efficiency of goods transport, and consequently strengthening the competitiveness of transport professionals.

SUCCESS or FAILURE FACTORS

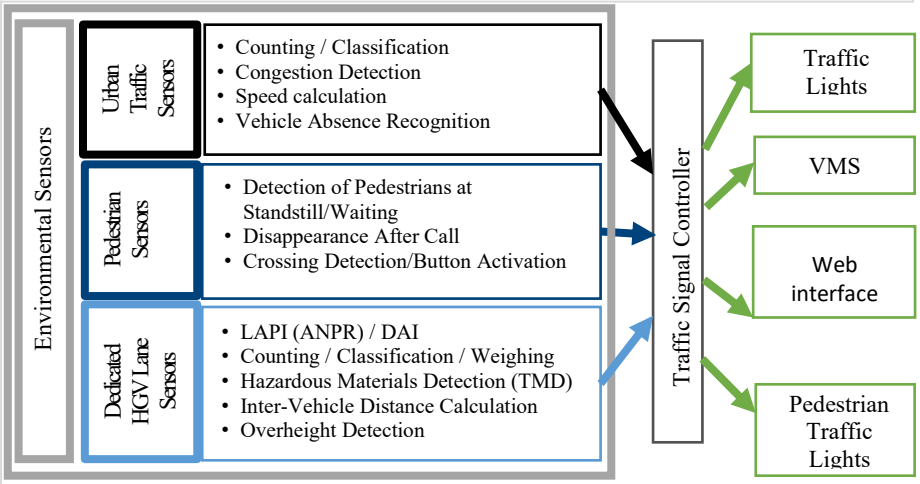
All simulated heavy goods vehicles (HGVs) reach their destination without significant delays due to congestion. The average travel time along the entire section is 12 minutes, with a total stopping time of 3 minutes and 40 seconds, resulting in an average speed of 32 km/h. The traffic signals at intersections are designed to prioritize the higher HGV flow on dedicated lanes (1,475 PCU/lane/direction/hour), while regular vehicles (825 PCU/lane/direction/hour) benefit from the same green time allocation, with no queue spillback issues observed. Cars travel the 5 km stretch at an average speed of 35 km/h.

Regarding pedestrian crossings, there are 15 managed on-demand. When a pedestrian is detected, the crossing is served 29 seconds later to ensure the minimum green time for the dedicated HGV lanes is maintained. On average, pedestrians take 54 seconds to cross the entire road, including detection time, with an average speed of 5 km/h.

OUTLOOK & TRANSFERABILITY

To ensure the optimal operation simulated in the Aimsun software, the vehicle and pedestrian detection system equipment, along with the Dynamic Lane Management System, must form an intelligent transportation system with the following functions and characteristics:

A definition of the network designed to accommodate heavy traffic is presented below:



MORE INFORMATION
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Publications:

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- Maaroufi, M.M, Stour, L., Agoumi, A. (2021). A New Approach of Smart Mobility for Heavy Goods Vehicles in Casablanca. Ambient Intelligence and Smart Environments. Volume 29: Intelligent Environments 2021. 98-107. https://ebooks.iospress.nl/doi/10.3233/AISE210086

GOOD PRACTICE FACT SHEETS

5.29. EMERGENCY LEZ IN BRUSSELS (BELGIUM)

Keywords: Emergency air pollution scheme, UVAR, Brussels-Capital Region, PM10, NO2, ANPR, Air Quality Directive 2008/50/EC, public health

DESCRIPTON IN SHORT

The Emergency Air Pollution Scheme in Brussels is a temporary Urban Vehicle Access Restriction (UVAR) initiative aimed at mitigating severe air pollution episodes. Operational since January 2020, the scheme primarily focuses on reducing vehicular emissions during critical periods of poor air quality. It is geographically restricted to the Brussels-Capital Region, encompassing an area of approximately 161 km². The scheme activates predefined restrictions targeting high-emission vehicles, particularly diesel cars, as a response to air pollution alerts triggered by particulate matter (PM10, PM2.5) or nitrogen dioxide (NO2) levels exceeding EU thresholds. Its main objectives include improving public health, enhancing air quality, and complying with European Union environmental standards. The scheme aligns closely with the "Plan PICS de pollution" by Brussels Environment, which details the response strategy to PM10, PM2.5, and NO2 peaks.

BACKGROUND

The establishment of this UVAR was prompted by chronic air quality challenges in Brussels, driven by high population density, extensive vehicular traffic, and climatic conditions conducive to pollutant accumulation. The European Union's Air Quality Directive (2008/50/EC) and the necessity to meet the WHO-recommended guidelines on PM2.5 and NO2 levels played a critical role in shaping the policy framework. A 2018 report by the European Environment Agency identified Brussels as one of Europe's urban areas with persistently high NO2 levels, primarily attributed to diesel engines. Public health studies further highlighted the significant adverse effects of poor air quality, linking it to respiratory diseases and premature mortality.

In 2019, Brussels Environment launched the "Plan Air Climat Energie" to address these challenges, with the Emergency Air Pollution Scheme as a core measure. Additionally, the "Plan PICS de pollution" further outlined specific measures and thresholds for activating emergency restrictions, based on air quality monitoring data. These measures are designed to comply with Belgium's commitments under the EU Green Deal and Climate Law.

Pollution peaks are signaled with measures ("drive calmly")

ELEMENTS

The Emergency Air Pollution Scheme operates under a graded restriction system. During declared air pollution alerts, access to the Brussels-Capital Region is restricted for vehicles not meeting minimum Euro emission standards, particularly Euro 3 and below diesel vehicles. Alerts are triggered when PM10 levels exceed 50 µg/m³ over 24 hours, PM2.5 surpasses 25 µg/m³, or NO2 concentrations exceed 200 µg/m³ per hour for three consecutive hours.

Exemptions are granted to emergency vehicles, public transportation, and vehicles for individuals with disabilities. Additionally, temporary exemptions apply to specific economic sectors and essential services during the initial phases.

Implementation relies on automatic number plate recognition (ANPR) cameras strategically deployed across the region to monitor and enforce compliance. Real-time air quality monitoring data, provided by Brussels Environment, triggers the activation of restrictions. Notifications are disseminated to the public via digital platforms, SMS alerts, and regional media outlets. A fine system is in place for non-compliance, with penalties ranging from €150 to €350 per violation. The scheme is supported by a dedicated web portal for registration, exemptions, and access to real-time updates.

The table on the right illustrates the four air pollution level thresholds of this air pollution scheme:

The Brussels Air map allows people access air quality information in real time

Emergency scheme

Levels	Information and awareness	Information and intervention	Intervention 1	Intervention 2
is activated when daily concentrations are:	**PM2.5:** 35 to 50 µg / m³ **PM10:** 51 to 70 µg / m³	If 'Information and Awareness' has been applied for 2 days	**PM2.5:** 51 to 70 µg / m³ **PM10:** 71 to 100 µg / m³ **NO2:** 151 to 200 µg / m³	**PM2.5:** 71 µg / m³ and more **PM10:** 101 µg / m³ and more **NO2:** 201 µg / m³ and more
Speed		- on the **Brussels** ring road and on the motorways in the **Flemish** and **Walloon** Region to limited to **90 km/h** - on the roads that are usually 90 km/h or 70 km/h limited to **50 km/h**	- on the Brussels ring road and on the motorways in the **Flemish** and **Walloon** Region to limited to **90 km/h** - on the roads that are usually 90 km/h or 70 km/h limited to **50 km/h**	**Driving ban:** - for all motorized vehicles in the Brussels Region
Public transport and bike sharing	- home office - using different means of transportation than using the car	- **free**	- **free**	- **free**
Heating	- **limit** indoor heating - **avoid** heating with wood	- with wood is **prohibited**	- with wood is **prohibited** - limit indoor heating to 20°C	- with wood is **prohibited** - limit indoor heating to 20°C

RELATED MEASURES

Complementary measures bolster the scheme's effectiveness and public acceptability. These include enhanced public transportation services during pollution alerts, such as free fares on STIB (Société des Transports Intercommunaux de Bruxelles) networks and increased frequency of metro, tram, and bus services. Park-and-ride facilities are promoted as alternatives for commuters. Awareness campaigns, emphasizing the health risks of air pollution and the benefits of the scheme, are regularly conducted to encourage behavioral shifts towards sustainable mobility.

Furthermore, the scheme is integrated into Brussels' broader Low Emission Zone (LEZ) framework, which started in 2018 and gradually phases out older vehicles through escalating restrictions. The "Plan PICS de pollution" also recommends coordination with neighboring regions to prevent pollution displacement and ensure cohesive implementation. Findings from the "CurieuzenAir" project underline the necessity of these measures to address regional air quality disparities effectively.

IMPACTS, BENEFITS, NEGLECTED COSTS

Since its implementation, the scheme has contributed to a noticeable reduction in NO2 levels during activation periods, with air quality data from 2021 indicating a 15% decrease in emissions on high-alert days. Between 2020 and 2023, annual PM10 levels in the region dropped by 8%, and NO2 concentrations saw a 12% decline, according to Brussels Environment. Health outcomes have improved, with hospital admissions for respiratory conditions declining by 8% during these episodes.

Economically, the scheme's implementation costs, including ANPR infrastructure and public transportation subsidies, are estimated at €10 million annually. However, this is offset by public health savings of approximately €30 million per year due to reduced pollution-related illnesses. Criticisms have emerged regarding the scheme's socioeconomic impacts, particularly on low-income households reliant on older, high-emission vehicles. Additionally, some sectors, such as logistics, have reported increased operational costs during restriction periods. Studies evaluating Low Emission Zones in Belgium's cities have highlighted spatial spillover effects and the necessity of targeted economic support to mitigate these impacts.

The emergency action plan depends on the air peak treshhold (see elements section). The impact of the measures undertaken depends on the impact of Treshold n°2 (worst case scenario) are :

- (1) Traffic ban for all vehicles, except for certain specified categories. The Brussels Ring (R0) is not affected by this measure.,
- (2) Free public transport (STIB) for the day concerned.
- (3) Free daily ticket for Villo! (the bike-sharing system).
- (4) Ban on wood heating, except when it is the only heating source in the home.
- (5) Limitation of indoor temperature to 20°C in buildings where the heating system is classified as an environmental permit installation. Private homes, hospitals, nursing homes, nurseries, and swimming pools are not affected by this measure.

SUCCESS or FAILURE FACTORS

The scheme's success can be attributed to robust stakeholder collaboration between Brussels Environment, STIB, and local governments. Public communication and transparency about the scheme's objectives and mechanisms have fostered greater public compliance. Notably, public acceptance was bolstered by preemptive outreach campaigns launched in 2019, prior to the scheme's implementation.

However, limited exemptions and perceived inequities in enforcement have sparked criticism, highlighting the need for more inclusive policies. The scheme's reliance on ANPR technology also faced initial challenges related to data privacy concerns, which were addressed through legislative amendments ensuring compliance with GDPR.

A key lesson is the importance of integrating social equity considerations into UVAR designs to ensure broader public acceptance and effectiveness. For example, providing targeted financial support for low-income households to upgrade their vehicles could enhance public support.

OUTLOOK & TRANSFERABILITY

Looking forward, the Brussels-Capital Region plans to integrate the Emergency Air Pollution Scheme into a more comprehensive Low Emission Zone (LEZ) policy by 2026, with stricter standards and expanded geographical coverage. The introduction of dynamic pricing mechanisms for vehicle access and enhanced real-time monitoring capabilities is also under consideration.

The scheme's transferability to other urban areas depends on factors such as existing public transportation infrastructure, legislative support, and public willingness to adopt cleaner mobility options. For successful implementation elsewhere, policymakers should ensure robust data infrastructure, equitable exemption criteria, and adequate public outreach. Cities with similar air quality challenges can benefit significantly by adopting tailored versions of this UVAR policy while addressing local socioeconomic contexts.

MORE INFORMATION
Contact:

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Publications:

Brussels Environment (n.d.). "Plan PICS de pollution bruxellois: PM2.5, PM10, et NO2." Available at: https://qualitedelair.brussels/content/plan-pics-de-pollution-bruxellois-pm25-pm10-et-no2; European Environment Agency (2018). "Air quality in Europe – 2018 Report." ; European Union (2008). Directive 2008/50/EC on ambient air quality and cleaner air for Europe. ; Brussels Environment (2021). "Annual Air Quality Report." ; Brussels Government (2019). "Plan Air Climat Energie ; WHO (2018). "Ambient Air Pollution: Health Impacts and Recommendations."

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18.02.2025, Version 2

6. CONCLUSIONS AND NEXT STEPS

This report on "URBAN VEHICLE ACCESS REGULATIONS (UVAR)" includes a wide range of access regulation measures focused on improving the social, economic and environmental situation of urban areas all around the world, with different kinds of access regulations that bring different impacts and, at the same time, lessons.

The access regulations approach include Emission Zones, including different types such as Low/Limited Emission Zones (LEZ), Zero Emissions Zones (ZEZ) or Ultra-Low Emissions Zones (ULEZ), such as those of Beijing (China), Brussels (Belgium), Lyon (France), Padua (Italy), Johannesburg (South Africa), Antwerp (Belgium), Madrid (Spain), Barcelona (Spain), London (UK), which are mainly focused on improving air quality and reducing traffic congestion, limiting certain vehicles based on their emissions, with exceptions. On the one hand these cases show that UVARs can be useful to improve public health and traffic. On the other hand, the LEZ often raise spatial equity concerns as well as public opinion resistance, especially from peri-urban commuters.

Over and above emission access regulations, the Emergency air Pollution Schemes (EPS), such as the Emergency LEZ in Brussels (Belgium), are exceptional UVARs that is triggered when pollution pass a certain threshold. In this case, similar to LEZ (in fact, the LEZ is included among it), the main focus is to reduce air pollution but only when it rises above predefined values. Whenever an emergency is activated, there are several measures, not only restricting traffic, but also compensatory measures like free public transport and the bicycle-sharing system or limiting indoor temperatures in permitted installations.

Another UVARs type studied are Congestion Charging and Toll Schemes (CS), such as Seoul Congestion Charging Scheme (South Corea) and Kawasaki Environmental Road Pricing Initiatives (Japan). These access regulations are based on pricing certain vehicles users or access to urban areas, promoting alternative routes while aiming to improve environmental and infrastructure concerns.

Moreover, Limited Traffic Zones (LTZ) are another UVARs type, such as the Maribor Limited Traffic Main Square (Slovenia), Brussels School Streets (Belgium), Vitoria-Gasteiz Superblocks (Spain), Alternating Traffic Restrictions (Mayotte) or Buenos Aires Centre Environmental Area (Argentina). The different limitations, by periods of time such as the Buenos Aires or Maribor cases, or to certain vehicles like the School Streets, let infrastructure and citizens coexist under improved circumstances, even if it requires strong communication and participation of stakeholders.

Furthermore, another kind of regulation are Pedestrian Schemes (PED), such as Timișoara Pedestrian-Friendly City Centre (Romania), Nantes Pedestrian Zone (France), Bruul Pedestrian Commercial Street (Belgium) or Medina of Tunis (Tunisia). This access regulation, which is common worldwide, includes areas designated exclusively for pedestrian use, where motorised vehicle access is restricted, and can bring important benefits from a social and economic perspective, and some of them are related to business streets and historical centres and can support urban areas, such as strengthening tourism development and local cultural identity.

Additionally, Parking Schemes (PARK), such as the Québec Parking Scheme (Canada) or Lyon Parking Pricing Scheme (France), aim to promote less-polluting and less space-consuming vehicles in some areas, by pricing it is depending on the kind of vehicle itself.

Finally, Lorry Bans & Delivery Time-Windows (PARK) are another UVARs category studied, like the cases of Strasbourg Delivery LEZ (France), Timisoara Drop-Off Points (Romania), Timișoara's Heavy Vehicle Access Scheme (Romania), Urban Freight Distribution and Access in Fez (Morocco), Ghent's Lorry Access Regulations (Belgium) and Casablanca Lorry Lanes (Morocco). Their aim is in general similar: improving traffic condition, health and environmental background by reorganizing the way logistics and deliveries work in some areas. In that way, instead of individual choices or business decisions, processes become more efficient - from a global perspective, while ensuring commercial and industrial activities are not restricted.

6.1. LESSONS LEARNED

Urban Vehicle Access Regulations (UVARs) continue to evolve as cities experiment with new approaches to address air quality, traffic congestion, and public space reallocation. The case studies collected in this report show that these access regulations can be valuable tools to support sustainable urban mobility and reduce the negative impacts of motorised transport. UVARs contribute to long-term goals such as:

- Achieving Climate Targets: Cities align UVARs with national and international environmental commitments, such as the EU's Green Deal and the Paris Agreement.
- Enhancing Public Health: By curbing vehicular emissions, UVARs help reduce respiratory diseases and improve overall well-being. The effects of urban traffic noise pollution on health could decrease as well.
- Supporting Economic Efficiency: Reduced congestion leads to lower fuel consumption, decreased transport costs, and improved productivity.
- Modal shift to cycling, pedestrian or public transport.
- Reclaiming public spaces for local communities and non-motorised users.

The case studies confirm that these outcomes are not uniform. Local context plays a critical role in shaping both implementation and impact. Differences in urban form, governance arrangements, available resources, and complementary policies contribute to the observed variability in results. While some cities have achieved substantial improvements in environmental quality and mobility efficiency, others have experienced unintended consequences, such as traffic displacement to adjacent areas or access difficulties for certain user groups.

One recurrent observation is the scarcity of robust scientific evaluations. Many UVARs are implemented without systematic monitoring or impact assessment frameworks, particularly regarding less visible or long-term effects. This is particularly evident in cases such as Casablanca's heavy vehicle lanes or Padua's Limited Traffic Zone where potential neglected effects of the access regulations are not explored. This limits the ability to draw firm conclusions about effectiveness and hampers knowledge transfer between contexts.

Another key finding is the geographical concentration of case studies. Most of the documented examples (Madrid, Antwerp, Nantes, Lyon, etc.) come from large cities in high-income countries in western Europe, often supported by significant institutional and financial resources. This raises questions about the global applicability of the findings and points to the need for more evidence from smaller cities and from low- and middle-income countries, where challenges and constraints may differ significantly.

The diversity of UVAR types and contexts also make comparison difficult. Case studies vary widely in scale, regulatory design, technological infrastructure, enforcement mechanisms, and timelines. While this diversity reflects the flexibility of UVARs as a policy tool, it complicates the identification of transferable patterns and generalisable impacts.

Despite these limitations, the collected examples highlight some common dynamics, which will be further developed in the briefing note. For instance, initial public resistance is a widespread phenomenon (Brussels, Lyon, Barcelona).

Lastly, some case studies illustrate spillover effects or unintended consequences. For example, Brussels' LEZ triggered debates around peri-urban impacts, where vehicle restrictions inside the zone may have shifted pollution and congestion to surrounding areas. Similarly, in London, the expansion of the ULEZ raised concerns about equity for those living on the city's outer margins, especially low-income households reliant on older vehicles. However, in several cases such as in Vitoria-Gasteiz, acceptance has grown over time, as the benefits of UVAR become more tangible.

Overall, the review of case studies confirms that UVARs can play a significant role in advancing urban policy goals. At the same time, it reveals the complexity of their design and implementation, and the importance of context-sensitive approaches. The diversity of experiences gathered in this report offers valuable insights into the operational realities of UVARs and paves the way for deeper analysis. These themes, including evaluation practices, spatial and social equity, and transferability will be further explored in the forthcoming briefing note.

6.2. NEXT STEPS

The objectives of this working group are to answer preliminary research questions:

- Are UVAR's experimented with in all contexts (including developing and low-income countries), beyond the strong push for such measures in high income countries?
- What are the advantages and disadvantages of the various UVARs solutions experimented with or implemented worldwide?
- What are the prerequisites for developing these solutions, considering the heterogeneity of urban territories and cultural contexts around the world?
- Is it possible to avoid the risk of creating a fragmented patchwork of urban areas with new 'border lines' across urban and peri-urban areas in metropolitan regions, and thus new territorial inequalities (or the exacerbation of existing ones)?
- What recommendations can be made to guarantee the acceptability of UVARs?

Regarding those questions, the work done by this Group has led to important lessons and stimulated cooperation and diffusion of UVARS from professionals from different places, including developing countries. As has been stated, even though the solutions are not universal, experience can be used when applying measures, taking into account the economic, social and environmental circumstances of the case.

Building on the case studies from this report, the Technical Committee 2.1.2 continues to explore UVARs. The next step is a briefing note that will analyse the UVAR case studies, sharing the lessons learned, and proposing recommendations for UVARs.

7. GLOSSARY

Term	Definition
AQI	Air Quality Index (used to monitor pollution levels and trigger emergency schemes)
ANPR	Automatic Number Plate Recognition (technology for UVAR enforcement)
CPZ	Controlled Parking Zone (permit-based or paid parking areas with restrictions)
CS	Congestion Charging / Urban Toll Schemes
Dynamic Pricing UVAR	Charging systems that vary based on real-time traffic and pollution data
Eco-Mobility Zone	Area reserved for non-motorized and ultra-low-emission transport modes
EAP	Emergency Air Pollution Scheme
HGV	Heavy Goods Vehicle Access Regulation (restrictions on freight vehicles)
HOV Lane	High-Occupancy Vehicle Lane (restricted to vehicles with multiple passengers)
LEZ	Low Emission Zone
LOR	Lorry Access Regulation / Delivery Time Windows
LTZ	Limited/Low Traffic Zones
Occupancy-Based UVAR	Restrictions based on vehicle passenger numbers to encourage carpooling

PARK	Parking Regulation under UVAR (controls access based on emission levels, time limits, or user status)
PED	Pedestrian Zone (vehicle-free areas with limited exceptions)
Permit-Based Access Control	System where access is granted only to pre-registered vehicles based on compliance criteria
PPZ	Pollution Pricing Zone (charging based on vehicle emissions)
Residential Parking Scheme (RPS)	Parking permits or restrictions based on residency status
Smart Road Pricing	A dynamic tolling system that adjusts fees based on congestion and environmental conditions
Soft UVAR Measures	Non-restrictive policies like incentives for public transport and cycling
SUMP	Sustainable Urban Mobility Plan
Superblocks	Urban areas where car traffic is heavily restricted to promote active mobility
Temporary UVAR	Short-term vehicle restrictions for events, construction, or pollution control
Time-Window UVAR	Schemes allowing vehicle access only during certain hours
UAP	Urban Access Permit (digital or physical permit for restricted zones)
ULEZ	Ultra-Low Emission Zone
Urban Vehicle Access Regulations (UVARs)	General term for measures that regulate vehicle access in cities

Vehicle-Type-Based UVAR	Restrictions based on vehicle category (e.g., banning motorcycles, diesel cars, or heavy-duty trucks)
ZEZ	Zero Emission Zone
ZTL	Italian/Spanish/French term for Limited Traffic Zone

8. ANNEX

8.1. ANNEX 1 "CASE STUDY FORM – FACT SHEET"

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GOOD PRACTICE FACT SHEETS

Nr. UVAR (Location)

Keywords: [Type of UVAR], [Objectives/goals], [Challenges/issues], [Outcomes/impact], [Vehicles affected], [Geography], [Innovations/adaptations]

DESCRIPITON IN SHORT	Provide a concise **overview** of the chosen case study. Include key details such as its purpose, implementation date, geographical coverage, and the main objectives. What is it about? Since when ? • 20% - 30% of the page
BACKGROUND	Explore the **background** and the reason leading to the establishment of the UVAR scheme. Highlight the (peri-)urban concerns that prompted the need for such an UVAR application. Mention any **relevant legislation or policies** that influenced its development. • 30 – 40% of the page
ELEMENTS	Outline the **key components** and features of the UVAR scheme/policy. This could include the types of vehicles affected, restrictions enforced, and any exemptions. Explain how the UVAR operates, and the tools used (**technology, infrastructure, services)** in place for implementation, administration, monitoring and enforcement. • 30 – 40% of the page

RELATED MEASURES

Discuss **complementary measures or initiatives** associated with the UVAR policy/scheme. This may include push and/or pull measures. Show how these measures contribute to the **overall goals**.

- 20 - 25 % of the page

IMPACTS, BENEFITS, NEGLECTED COSTS

Analyze and discuss the **impact** of the UVAR scheme on the (peri-)urban areas.

Highlight any measurable **improvements** since its implementation (based on data, research, expert knowledge…).

Discuss the possible **adverse effects**. Be critical.

- 20 - 25 % of the page

SUCCESS or FAILURE FACTORS

Identify the **key success/failure factors** that have contributed to the (in)effectiveness of the UVAR policy/scheme. This could involve public engagement and acceptance, collaboration with stakeholders, or innovative technologies.

Highlight **lessons learned (success or failures)** that could be valuable for other (peri-) urban areas considering implementing such an UVAR policy scheme.

- 20 - 25 % of the page

OUTLOOK & TRANSFERABILITY

Discuss the outlook of the UVAR policy/scheme, including any **planned developments, expansions, updates, or adjustments.**

Assess the **potential for the transferability** of this scheme/policy to other (peri-)urban areas.

Discuss factors that may influence the **success of implementing** a similar UVAR scheme/policy in different contexts. Give some **pieces of advice** such as conditions for transferability.

- 20 - 25 % of the page

MORE INFORMATION

Contact:

[Email]

Publications:

[url inlk]

Author: (TC 2.1.2 PIARC member)

XX.XX.2024, Version 1

8.2. ANNEX 2 "TERMS-OF-REFERENCE"

2.1.2 Urban vehicle access regulations (UVARs)

Purpose: The purpose of this work is to study different solution of urban vehicle access restrictions and regulations. Low emission zones, pedestrian zones and congestion charging zones are all examples of this kind of solutions.

The goal is to evaluate the effectiveness in terms of congestion mitigation also from the point of view of an integrated urban transportation plan, to analyse the benefits and potential neglected cost. It is noted that UVARs will be more effective if introduced along with alternative multimodal solutions.

This work will be made in coordination with zero/low emission zones treated in TC3.4.

Preliminary research questions: Many cities struggle with the balance of congestion, "liveability", air pollution, noise levels, accessibility, damage to historic building and other pressures of urban life. The effects of these phenomena highlight the problematic reigning in urban areas across the World. Is it possible to avoid the risk of creating a fragmented patchwork of urban areas with new 'border lines' across urban and peri-urban areas in metropolitan regions? In order to enable a wide use of UVARs without creating disproportionate barriers to mobility for citizens and goods, it's important to study guidance for the development of harmonised UVARs.

Importance to roads agencies: This work is important for road agencies and municipalities. The growing number of schemes for Urban Vehicle Access Regulations (UVARs) within the World may create confusion for citizens and businesses. This topic is created to increase transparency and, where possible, support the effectiveness of existing approaches to UVARs. This work is important to road agencies and public administration both if you refer to external of internal challenges. Between the external challenges we could cite: EC22 – reducing greenhouse gases from the road sector and EC4 – responding to increased automation of driving. Between the internal challenges this kind of work is connected to IC1 – increasing use of varying funding models for road investment.

Audience: The work will be fruitful both for road agencies, practitioners and researchers that are involved in Urban vehicle access regulations (UVARs). Is important to acknowledge the environmental, social and environmental objectives of these actions.

Deliverables: Literature review, seminar.

Low and lower-middle income countries: Urban vehicle access restrictions and regulations could have a direct impact on daily mobility needs. The deliverables should alleviate the possible impact of these kind of policies on people and citizens that live in low and lower-middle income countries.

Gender inclusion & diversity: Women generally have different trip chains, shorter trips close to home and other mobility characteristics. All these aspects should be included as a guidance for the Urban vehicle access regulations (UVARs) technical report.

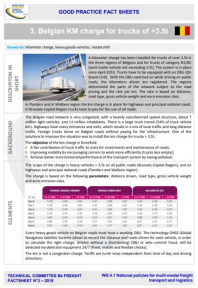
Potential duration: 24 months.

PIARC (World Road Association) Strategic Plan -2024-2027 Technical Committee 2.1 -Roads for Accessibility and Mobility in Urban and Peri- Urban Areas. (n.d.). Retrieved July 9, 2024, from https://www.piarc.org/ressources/documents/source/Technical-Committees-2024-2027-Terms-of-Reference/102d1ff9-42998-Terms-of-Reference-CT-2.1-Roads-for-Accessibility-and-Mobility-in-Urban-and-Peri-Urban-Areas.pdf

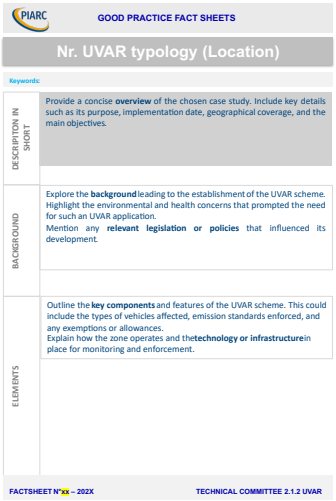
8.3. ANNEX 3 "INSTRUCTIONS AND GUIDELINES FOR THE COLLECTION OF CASE STUDIES (FACT SHEETS)"

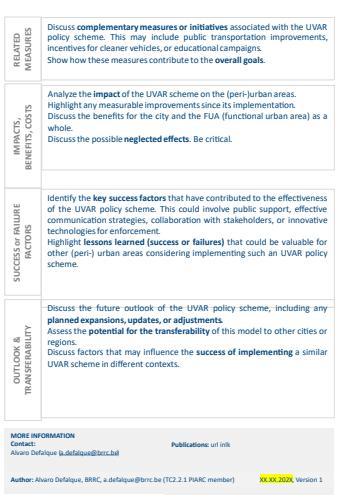
Good practices FACT SHEETS

- The purpose of these fact sheets are to highlight projects, initiatives and policies that have been utilized by member countries in an effort to provide increased efficiencies within their respective UVAR schemes
  - **Format** : 2 pages recto-verso with text and figures
  - **Target audience** : PIARC UVAR experts, Road administrations,….
- **Content challenge**
  - **Geographical representativity** of the Good practices
  - **Diversity** : cover all relevant types of "UVAR" measures, schemes, zones, regulations,…
    - Cf. categories master list literature review
    - Not necessarily linked to literature reviewed
- **Good practices vs. best practices**
  - 'Best': a practice that has been proven to work better than other methods over time
  - 'Good': a practice that seems to work, but not (yet) proven to be the best method
  - Preferably with realized effects, but surely with expected effects



Similar but adapted to the WG 2.1.2 on UVAR





Additional tips to fill the factsheet with UVAR good practice

Remember to use data and statistics where possible to support your points and make the factsheet informative and credible.

- 2 or 3 per page
- Design of the blocks is free

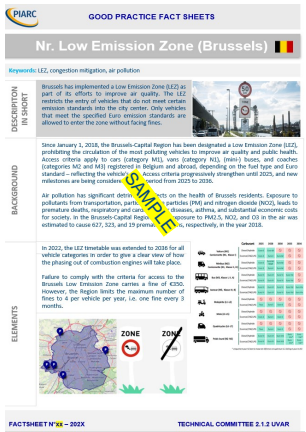
5. Good practices

- **Front page aspects**

Picture, table, schedule
- 2 or 3 per page
- Design of the blocks is free

1 **Name** and **keywords**
- Both preferably on one line

2 **Description** in short
- 20% - 30% of the page
- What is it about
- Status – since when implemented
- Where
- …



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5. Good practices

Front page aspects

3 Background
- 30 – 40% of the page
- Reason to implement / objective
- History / follow-up to previous policy or new policy choice
- Legislation

4 Elements
- 30 – 40% of the page
- Key aspects of the good practice: depends on the practice.
- e.g. necessary conditions, clarifying the context, scope, …

5. Good practices

Back page aspects

5 Related measures
- 20 - 25 % of the page
- measures and schemes that are linked to it, that result from it, that are conditions for success, ...

6 Impacts, benefits, neglected costs
- 20 - 25% of the page
- Proven effects (based on data)
- Expected effects (based on research / models)
- Potential effects (based on expert knowledge)
- Neglected costs

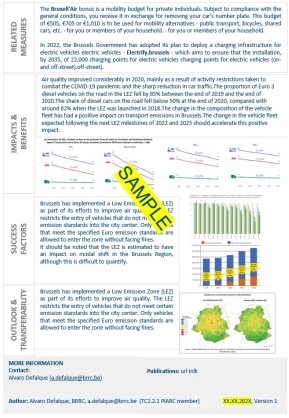
5. Good practices

Back page aspects

7 Succes (or failure) factors
- 20 - 25 % of the page
- What was crucial for the practice to make it a success or why did the scheme fail.
- E.g. cooperation, communication, enforcement coordination, public support….

8 Outlook & transferability
- 20 - 25% of the page
- Possible or expected future adjustments
- Expected evaluations
- A word on possible implementation in other countries (HIC / LMIC), opportunities, conditions….

9 Contact, publications, author of the factsheet



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